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TO OUR READERS.

It is now rather more than ten years since this Journal was first published, it having commenced its existence, as, doubtless, many of our friends and supporters will remember, on November the fifteenth of the year 1872.

How interesting, mentally to glance over the intervening years and to note the changes which have in the electrical, perhaps more rapidly than in any other, branch of science, gradually, and for the most part silently, taken place!

Silently? Yes; in the main, excepting for those brilliant flashes of genius which at intervals have marked the progress of the electric era.

Ten years ago, telegraphy, alone of the practical applications of electricity, engaged much of the thoughts of electricians; the word telephone was scarce heard; and electric light machines and motors were but emerging from the magneto-electric (as distinguished from the electro-magnetic) type. The need for storage batteries was yet unfelt, and the present lasting qualities of the incandescence lamp yet unattained.

With all the chief advances made in these directions, accompanied, as they have been, by numerous progressions of a minor kind, what vast new fields for exploration, and means therefor, have been opened up! Who can forecast the achievements to be announced during the next decade? It would seem that we are but on the verge of all that man, by means of electricity, can accomplish; and it is possible that those feats of our inventors which have astonished and fascinated the attention of the civilised world are but as summer lightnings to a tempest, compared with the importance of the inventions and improvements yet to come; inventions, the shadows of which are, perhaps, even now detected by the sharpened senses of those who, by assiduous study and thought, have accustomed themselves to foresee results as yet not dreamt of by others of less capacity or mental energy.

Yes, much will be done; and, through the information we from time to time shall publish in our columns, we hope still to be an humble means to this great end. That our endeavours in this direction have been appreciated the results have proved to us, and we shall, with our next issue, enter on the publication of the twelfth volume with the determination to merit, as far as possible, the consideration and kindness which have been showered on us by our readers, and to leave nothing wanting to make the "Review" worthy of the important cause which it advocates, and which it is our ambition to assist.

Our Readers we again ask to strengthen our hands by sending early information, and by contributing to our "Correspondence" columns; and, at the same time, we desire to thank those who have so liberally responded to a similar request we made at the commencement of this year. Indeed so bountifully were our wishes responded to that the requirements of our "Notes" and "Correspondence" columns demand some immediate consideration on our part to enable us to place all the information before our readers which is constantly flowing freely towards our pages.

Beyond some slight alterations in the conduct of these columns we do not contemplate any change, of importance, in our programme; the great success of the last year having convinced us that our existing arrangements have given a larger amount of satisfaction to our subscribers than we had even dared to hope. With their assistance, and encouraged by the numerous kindly expressions of sympathy in our work which we at various times have received, we shall go forward to the labour of another twelve months, feeling that correct information on subjects electrical, combined with criticism unbiassed by fear or favour, are what our readers require, and what we should, and are determined to supply.

"*Rien n'est beau que le vrai.*"

ELECTRICAL EXHIBITIONS.

By W. H. PREECE, F.R.S.

(Paper read before the Society of Arts, on Wednesday, the 13th inst.)

(*Continued from page* 488.)

A very interesting exhibition of quite a different character took place in September and October last, in Munich. Though it was called international, it was purely German. There were only 170 exhibitors, but what was shown was good. The principal object aimed at was to display in the very best artistic manner, the power of electricity to illuminate space, and this was done with very great success. In the centre of the building an exceedingly handsome fountain, brilliantly lit up by coloured rays, played in the centre of a pretty garden, laid out with great taste and care.

Here we saw a quaint representation of the past and present. The past—an old hut or cottage, furnished with the oldest and blackest oak, a plain and simple table and stool, a spinning wheel, a crucifix, an iron clock, lit up by an old greasy oil lamp. The present—a well-arranged library of the present day, fitted up with the most artistic and expensive furniture, and all that luxury, wealth, and taste could command, beautifully illuminated by glow lamps.

In the nave there was a copy of an old Norman church, fitted up inside with all the appurtenances of a church, a lay figure kneeling before a lectern, with all the gorgeous robes of a high dignitary of the church of Rome, and upon whom was playing the brilliant ray of an arc lamp. The effect was picturesque and striking.

There was also a theatre capable of holding 300 people, fitted with a stage, footlights, set scenes, &c., in which, every evening, pantomimic representations took place to show how electricity was adaptable for stage effects. There was also a picture gallery so illuminated. The chief feature at the exhibition was the transmission of power from the falls of the Iser at Hirschau, 5 kilometres off, to the building, and also from Miesbach, 57 kilometres (34 miles) off. The latter experiment was made by Marcel Deprez. Two wires were used, and half a horse-power was obtained. The experiment was the same as though a waterfall at Bath worked a circular saw in this room.

There was a new lamp shown, about which we may hear something further. It is the invention of a Signor Cruto, an Italian, who for 12 years has devoted his time to discovering a mode of constructing artificial diamonds, and has ended by producing a glow lamp! The lamp consists of a *tube* of carbon, and requires only half an ampère to work it, a result which, if carried out, will be of immense economy and importance. The production of the electric light has already been brought well into economical comparison with gas, and it only wants two or three inventions

of this kind to make it much cheaper than gas. Dr. Siemens considers it the light of the rich, but if the progress of the past two years is maintained, it will become ere long the light of the poor as well.

Among the curiosities exhibited there I was able to secure only one. It is an instructive and amusing series of photographs, taken by Dr. von Zeemssen—a celebrated electro-physiologist of Munich—of the face of the same person who has, involuntarily, been compelled to assume expressions of various emotions by the application of currents of electricity to various muscular nerves of the face.

The Munich Exhibition will be chiefly distinguished by the careful electric tests that have been made there by a very distinguished jury, aided by very perfect apparatus, and a splendid laboratory. The results are not yet published. They are looked forward to with much interest, for they are certain to be valuable and worthy of every confidence.

It will be gathered from what I have said that the chief peculiarities of the past exhibitions are these :—

At South Kensington we had a magnificent collection of the scientific condition of electrical apparatus at that date—1876. At Paris we had an equally magnificent show of their practical condition in 1881. At the Crystal Palace the commercial element stepped in, converting a picture of progress into a means of advertisement ; while at Munich science again comes in to fulfil its chief duty, to measure and compare. At Paris and the Crystal Palace medals and honours were distributed, but at Munich the far more sensible plan has been adopted of giving simple certificates of efficiency, showing plainly what each apparatus can do in its own particular sphere.

We are about to have not only a second exhibition at the Crystal Palace, but also one at the Westminster Aquarium. These are purely commercial speculations, and scarcely come within the remarks I have to make. Vienna is also to have an exhibition in the autumn, and doubtless they will be repeated in all chief cities.

What are the advantages of these electrical exhibitions ? They undoubtedly denote progress, and they instil and spread knowledge. They enable the public to see with their own eyes what is being done in special fields of manufacture and enterprise. They are useful in bringing to the notice of the many what is, perhaps, only known to the few ; but good wine needs no bush, and a good thing soon finds its way into notoriety without the necessity of an exhibition. For instance, Clarke's gas-lighting apparatus has not, to my knowledge, been shown at any exhibition, and yet its consumption is so great that, I am told, the manufacturers can scarcely cope with the demands. They excite emulation among inventors and manufacturers, and they strike out new paths for inquiry and appreciation. There was a striking exemplification of this at the Crystal Palace. Messrs. Verity, of King Street, Covent Garden, showed an extremely artistic and elegant mode of fitting up glow lamps—a mode which distinguished the Edison exhibit from all others. This fired up all rivals, and before the exhibition was over we had a display from Swan and Brush which rivalled, if it did not surpass, the pioneer.

International exhibitions bring foreign countries into more intimate unison, and nothing can be happier or more conducive to progress than the prevailing relations established by such a gathering at Paris.

When well matured and properly carried out, they not only respond to the public pulse, but they supply a decided want ; when ill-matured and injudiciously inaugurated, they tend to retard progress by compelling abstentions, and by descending to mere gigantic advertisements. As it was, both at Paris, the Crystal Palace, and Munich, many held aloof. At Paris, England made but a sorry show compared to what she could have done ; while at Munich, England, France, and North Germany were conspicuous by their absence.

There can be no doubt that progress is expedited by such exhibitions as that of South Kensington and of Paris. The Exhibition of 1851 gave an impulse to English art that has progressed by accelerating energy, and Paris has given a fillip to electric lighting that nothing will stop—not even the financial eccentricities that have characterised the mania of this year.

On the one hand, it is a question how far this mania is attributable to those exhibitions. A little knowledge is a dangerous thing, and a little knowledge of electricity with a fair insight into financial bubbling, has done what electricity cannot do—it has transferred gold from the coffers of the too confiding to the pockets of the too speculating. The rush of the public into these electrical appliances has appalled the initiated. Electric lighting is still in a tentative stage, but it is progressing with great rapidity. It has been shown to be practical, but it has not yet been proved to be economical. No one can say how far or how much it will be used, nor what are the best conditions for its installation, and while it is in this infantile state it is difficult to understand the action of so many local corporations, whose chief desire appears, in many instances, to strangle the bantling, rather than to encourage its growth. In the meantime the real, sound, commercial undertakings are checked in their progress, while the loud roaring speculator and wide-mouthed promoter have not yet been driven off the road.

Electrical exhibitions, when international, teach the lesson how ignorant we are of each others' actions and progress. They give an enormous impetus to the interchange of ideas, and when carefully considered, they must have a beneficial influence on practical progress and social improvement. Hence I would urge that exhibitors should eschew as much as possible mere commercial speculations, and wait patiently for that period when a great public want will force the Government to undertake the management of a great International Electrical Exhibition in London, fostered by the experienced authorities in South Kensington and supported by such communities as that of the Society of Telegraph Engineers and of Electricians and of the Society of Arts.

DISCUSSION.

The Chairman said Mr. Preece had described with great clearness the different kinds of exhibitions which had taken place, some recommending themselves more to the scientific mind, some to the practical improvers of the applications of electricity, and others to the public, as employers of electricity for lighting or other purposes ; and he had no doubt that all these exhibitions had their use. But the great interest of any exhibition must be as representing the real progress made, or work done. He agreed with Mr. Preece in hoping that the speculative and financial phase of electric progress, which had characterised the year now drawing to a close, would shortly be replaced by a phase of practical activity. One step had been gained by the passing of the Electric Lighting Act of the last Session, and he believed the authorities of the Board of Trade were now busily at work, framing those additional details which were necessary before the Act could be put into actual operation. The progress of this application of electricity would depend very largely on the public demand for it ; and he felt satisfied that it had so far passed the experimental stage, that it was capable of taking up a practical position for the benefit of the community. It was true that we did not yet know, from actual experience, what might be the economy of electric, as compared with other modes of lighting, for that could only be determined when it had been made use of on a large scale. All those who were connected with mechanical operations knew how different the application of a number of small steam-engines would be to that of one large one for carrying out any operation requiring any great mechanical power ; and, therefore, until machines were in use capable of producing very large results, worked by large engines, it was impossible to say what degree of economy might be attained.

Mr. J. N. Shoolbred said Mr. Preece had drawn particular attention to three exhibitions—the Loan Exhibition, which had fallen almost flat, the Paris Exhibition, in connection with which the Jablochkoff light had been shown in the Avenue de l'Opéra, and the Paris Exhibition of 1881—but the results described were not merely due to these exhibitions, they were the outcome of about fifty years of gradual experience, commencing with Faraday's discoveries in the Royal Institution. The electric light had been working on gradually, and had taken practical form in lighthouses at Dungeness, the South Foreland, La Hogue, and elsewhere. Therefore the scientific mind had been gradually ripening ; and with regard to the success which attended the labours of the International Congress of

Electricians at Paris in adopting the units, that also was really the result of some fourteen or fifteen years working with those units, which had been elaborated by a Committee of the British Association, under the chairmanship of Sir William Thomson. It was the fact of this committee having worked so successfully which enabled the units so readily to acquire an international character. There was scarcely an electrician now who was not familiar with them—not because they were adopted in Paris, but from long previous experience. The exhibition at the Crystal Palace might have been of a purely commercial character, but its usefulness could hardly be doubted, considering how many people were unable to visit the Paris Exhibition, who would gladly have done so, and an opportunity was then given to many Corporations and Local Boards to study electric lighting, the result of which might be traced in the passing of the Act of last Session. He did not think that Act would now have been law, but for the interest awakened in the subject by the Crystal Palace Exhibition. Mr. Preece had described, in connection with the Munich Exhibition, the contrast between the past and present, but a more striking illustration could hardly be found than the one on the Thames Embankment, not far from that place where Cleopatra's Needle looked down on the Jablochkoff candles at its base. He hoped the amount of speculation which had been taking place in connection with electricity, would be tempered with common sense, and that in the end no great harm would be done to any one.

Mr. Currey asked if Mr. Preece could give any definite information as to the amount of power used by M. Marcel Deprez to generate the half-horse-power which he obtained in the Munich Exhibition.

Mr. Preece, in reply, regretted that the questions asked were so few and simple. The one put by Mr. Currey was very pertinent, and he might say at once, that although the experiment referred to was exceedingly valuable in showing that it was possible to bring half-a-horse-power from a distance of thirty-four miles, in a straight line, which was equal to about seventy miles, because a double wire was used, still, the half-horse-power received at Munich was only 25 per cent. of the power put into the machine at Miesbach. A gas-engine was employed there, and measured exactly by the brake that was put into the dynamo machine at Miesbach, 130 kilogrammetres, while it gave out at Munich 30 kilogrammetres, or, in other words, two horse-power were put into the machine at Miesbach, and half-horse-power came out at Munich. This was not a very high result; at first M. Deprez himself thought that the machine at Miesbach was worked by one horse-power; but the careful measurement made by the jury had dissipated that illusion, and the French journals were now occupied in trying to explain away the mistake made in the first instance. With regard to the observations of Mr. Shoolbred, he was bound to admit that he had, very properly, taken him to task for not having given sufficient credit to the Committee of the British Association for the establishment of the units which were accepted at Paris. The Committee of the British Association had been sitting for twenty years, and had taken an almost indescribable amount of trouble, the result of their labours being to place the whole system of electrical measurements on such a plain and satisfactory basis, that it required very little difficulty to convince foreigners of its simplicity and coherency; and it was solely owing to the ground having been cleared beforehand by the British Association that the object was so completely effected at Paris. With regard to the effect of the Crystal Palace Exhibition in expediting the progress of electric lighting, he would ask whether the progress made during the past year, great as it was, was a healthy progress, and would not the progress have been much more solid, very much more commercial, and much more sensible, if there had been no Crystal Palace Exhibition to excite the cupidity of speculators? Although the progress had been great, the mania had been greater; and the number of enterprises thrown upon the world had been outrageous, chiefly due to the unnatural excitement produced by the exhibition. He would even ask whether the Act of Parliament was called for, and whether the discussion in Parliament with regard to it had not had a tendency to check that solid material progress which true scientific research and experiment would have created? In his opinion the operation of the Act had been to check the progress of sound electrical enterprise in this country; it had been impossible to obtain from Corporations permission to lay wires underground, or to take any action whatever. Everybody had been waiting for this Act, and now it was passed every one was trying their utmost to strangle the electric bantling. He did not agree, therefore, that the Crystal Palace Exhibition was the cause of healthy progress, and he had very considerable doubts whether it would not have been very much better for Corporations to have allowed solid companies to have worked their way quietly, and to have waited another Session for an Act of Parliament. One effect of these exhibitions he had omitted to mention, and that was the readiness with which wants were supplied when they were made known. Engineers who had been accustomed to deal with large dynamo machines often found their watches act very eccentrically. Watches were usually made with vibrating springs of steel, and these springs, when they came in the immediate way of powerful dynamo machines, became magnetised. When so magnetised, their movements became very irregular. If you laid a watch down at night north and south it would very likely gain five minutes by the morning, whereas, if laid in the opposite direction, it might lose five minutes. But it was only necessary to point this out in order to have the evil remedied. He had found his watch become very eccentric in its movements from this cause, and he therefore put it in the hands of Messrs. Dent. Since then he had been travelling all over England in all sorts of weather, and had been amongst dynamo machines so powerful that he could feel the influence of the current on himself, but his watch had gone with perfect regularity. That day he had compared it with the current from Greenwich, and found that in the last five weeks it had not varied two seconds. This was owing to the application of a new principle in the balance-wheel suggested originally by Mr. Crookes and which had been adopted by Messrs. Dent and several other makers. He mentioned this to show how soon one's wants were met when they were made known, and one good result of the exhibition was to afford opportunities of making known such wants.

The Chairman then proposed a vote of thanks to Mr. Preece, which was carried unanimously, and the proceedings terminated.

A WEDGE AND DIAPHRAGM PHOTOMETER.

MR. SABINE has lately constructed a new photometer, which is shown in perspective in the figure. The stand supports a straight tube, at one end of which is an eye-piece, and at the other end a paraffine lamp. The middle

portion of the tube is cut away, and has slipped over it a collar, to which a frame is attached, carrying a wedge of neutral-tinted shade glass, adjustable by a rack and pinion. Inside the collar is fixed transversely a disc of ground opal glass, which the paraffine flame illuminates to a known degree. This disc constitutes the field of comparison, the illumination of which is adjustable by means of a series of diaphragms of known aperture, placed at the end near to the paraffine flame. At the side, between the wedge and the collar which carries it, is a narrow pane of ground opal

glass, just behind which a small mirror is fixed at an angle of 45° to the axis of the tube. This mirror is supported from the centre of the transverse opal disc in such a way that the support is hidden from the observer by the mirror itself—an arrangement which ensures the apparent juxtaposition of the illuminated surfaces which have to be compared. The light to be measured is placed on the right-hand side of the photometer and the wedge turned with the collar, so that the light falls normally upon the face of the wedge, passes through the wedge, through the pane of opal glass, and is incident upon the mirror, which reflects it to the eye of the observer. The wedge is shifted to interpose a greater or less thickness of the absorbing medium, till a balance is obtained, that is, until the apparent illumination of the mirror is equal to that of the field of comparison in the middle of which it is seen. If the range of the wedge is insufficient to admit of this, the degree of illumination of the field is altered by means of the diaphragms.

The employment of glass wedges for photometric comparisons is not new, having been already used by both Xavier de Maistre and Quetelet; but no practical photometer based upon this method has hitherto been constructed. The employment of diaphragms for increasing the range of the wedge is found to work well, and to enable the observer to adjust the illumination of the field with exactitude, the bright part of the paraffine flame being, of course, kept opposite to, and so as to well cover, the diaphragm aperture.

A table is constructed giving for each position of the wedge and for each diaphragm the value in standard candles of any light placed at one metre distance from the instrument; and if the light be placed at any other distance, the number in the table has simply to be multiplied by the square of the actual distance in metres.

For ascertaining approximately the amount of light which passes through any given coloured glass—such, for example, as orange glass—the eye-piece is furnished with a disc, containing small panes of white and different coloured glasses, either of which can be interposed at pleasure.

This photometer is made by Messrs. Elliott Bros. in two forms: one for use as a portable photometer, as in the figure, and the other on a more solid stand, for laboratory purposes.

ON THE CURRENTS PRODUCED BY NITRATES IN IGNEOUS FUSION ON CONTACT WITH CARBON HEATED TO REDNESS.

By M. BRARD.

IN a former paper (November 13th last) I indicated the result of my experiments on the properties of nitrates in contact with incandescent carbon.

To utilise these properties I undertook a first series of researches in order to obtain a special combustible which, burning in any furnace, might produce directly heat and electricity. In a second series I have undertaken, on the contrary, to realise a special furnace in which these physical agents may be produced with any combustible.

1. *Electrogenic fuel.*—My first attempt in this direction was the preparation of a small instrument which I call the electrogenic candle. This candle was made up of an agglomeration of coal-dust, cemented together with treacle in a mould where it was compressed with wires. These wires, issuing at one end of the little cylinder of carbon, form the negative pole. This agglomeration was then wrapped in a slender sheet of asbestos paper, which is in turn covered with copper wires constituting the positive pole. Then the whole is repeatedly steeped in a bath of melting nitrate, so as to form a coating of five to six millimetres in thickness.

The apparatus thus constructed has a rude resemblance to a candle, of which the carbon is the wick, whilst the nitrate takes the place of the wax. If the two poles are then connected by a galvanometer and the carbon heated to redness an energetic deviation of the needle is observed. This deviation persists during the whole duration of the combustion with abrupt variations indicating great variations of intensity. When once kindled the carbon continues to burn alone, melting briskly and giving a flame of great brilliance.

This candle burns quickly; the pure nitrate, which melts in contact with the ignited carbon, attacks it too energetically; the circumference of the charcoal before the centre is burnt is covered with a layer of a refractory salt which injures the continuity of the chemical action. Besides, the conducting wires lodged in the nitrate are more or less affected by the vivacity of the combustion. All these causes combined explain the variation in the intensity of the current. To make the candle a regular source of electricity and heat, it is necessary to eliminate these causes by alternating the combustion energy of the nitrate. I have effected this by mixing with the salt an inert body, such as a carbonate, and particularly ordinary ashes, which I introduce into the nitrate bath in the proportion of 2 parts ash to 1 part of nitrate. Under these conditions the carbon burns regularly; it is no longer encrusted, and does not melt at the point of contact of the mixture. The current acquires a remarkable constancy.

This result being acquired, it became possible to produce a true electrogenic combustible. The *briquette battery*, which I have constructed on this principle, is an agglomeration of ordinary coal, upon which rests a tablet of a mixture of nitrate and ashes, in the proportions mentioned above and separated from the coal by a thin sheet of asbestos paper. The poles of this element are constituted by metallic rods, which traverse the carbon and the nitrate and appear at one end of the mass. If one of these *briquettes* is in the fire by the end opposite to its poles, the carbon becomes red-hot, the nitrate melts, and a current is set up, feeble at first, but becoming more and more intense, until it reaches a maximum, which remains constant as long as the intensity of combustion in the fire remains constant.

Two of these *briquettes*, connected in tension, decompose water.

I hope to improve the yield of this battery, the specimens of which produced in the laboratory by hand are still rude. I hope to increase the electromotive force by mixing with the nitrates chlorates, the oxidising power of which is greater, and to lessen the resistance by omitting the sheet of asbestos, which the considerable resistance of the black carbon seems to render needless.

2. *Electrogenic furnace.*—The attempts which I have made to obtain a furnace producing directly heat and electricity with any combustible whatsoever, have not succeeded completely, because of the difficulty of insulating the elements. Still the results obtained show that the object in view is not impracticable.

We may conceive above a fire a central reservoir, containing nitrate kept in fusion, and letting this liquid flow in a constant and uniform manner upon inclined gratings. On these gratings rests the carbon of a series of small isolated fires, converging around a common centre. The construction of these fires is such that combustion ensues only on a limited space, near the grate which closes the lower extremity. Hence the combustion of the carbon in each fire takes place precisely where the melted nitrate flows. Metallic conductors or bars traverse the coal in each fire, and advance towards the nitrate-grate, which they approach as near as possible without actual contact.

The working of such an apparatus is explained easily; the ignited carbon and the melted nitrate meet in the conditions desired to produce a constant current. Each small furnace constitutes an element of which the nitrate-grate forms the positive pole, and the bars traversing the carbon the negative pole. The apparatus already constructed on this principle show that it is really thus. But hitherto I have not been able to avoid considerable losses by derivation and have been unable to obtain tension currents.—*Comptes Rendus.*

THE GILCHRIST LECTURES.—In our notice of these lectures recently delivered in Scotland (see ELECTRICAL REVIEW of the 9th inst.), we spoke of the lecturer as Dr. Carpenter. We should have said William Lant Carpenter, Esq., B.A., B.Sc., &c. We may add that a perusal of the syllabus of the lectures shows them to have been of a most instructive nature.

UPON THE ELECTRICAL EXPERIMENTS TO DETERMINE THE LOCATION OF THE BULLET IN THE BODY OF THE LATE PRESIDENT GARFIELD;

And Upon a Successful Form of Induction Balance for the Painless Detection of Metallic Masses in the Human Body.

By ALEXANDER GRAHAM BELL.

(A paper read before the American Association for the Advancement of Science, at the Montreal Meeting, August, 1882.)

(*Continued from page* 493.)

Original Experiments.

In the theoretical arrangement recommended by Profs. Trowbridge and Rowland (fig. 6) the primary coil, A, was of smaller diameter than the secondary, B. This had given us no better effects than the ordinary form of Hughes' balance (*see* fig. 2), in which the two coils, A, B, were of equal diameter. We then tried the effect of making the primary coil, A, of greater diameter than the secondary, B (*see* fig. 7), and in this case we appeared to obtain an increase of hearing distance. Five centimetres (2 inches) was, however, the utmost limit reached, when, on July 19th, Mr. J. Stanley Brown and Dr. Woodward visited my laboratory and witnessed some experiments. No difficulty was experienced in detecting a bullet held in the mouth by passing the exploring coil over the cheek; and the presence of a flattened bullet held in the clenched hand was also readily determined. Dr. Bliss, Dr. Reyburn, and Surgeon-General Barnes visited the laboratory next day and expressed themselves as very hopefully impressed by the experiments. These were subsequently repeated in the surgeon's room at the Executive Mansion for the information of Dr. Frank Hamilton and Dr. Agnew, who also seemed favourably impressed.

Such opinions from the surgeons in attendance upon the President, and the continued interest shown by Prof. Newcomb, encouraged me to proceed with the experiments.*

It was now determined to test the effect of each convolution of the primary coil, so as to arrive empirically at some idea of the best shape of coil. For this purpose Mr. Tainter constructed the instruments shown in fig. 8. Circular grooves were turned in two boards, one of which is shown in perspective at A and the other in section at D. An insulated copper wire could be pressed into any of these grooves so as to give the wire an exactly circular shape of known diameter, and the two ends were passed through an orifice in the back of the board, making connection with a similar ring of wire in the other instrument, as shown. A small secondary coil, B, of fine wire, which could be moved with moderate friction upon the horizontal rod, was connected to another similar coil, E, and to a telephone; and a small brass ring, C, which could also be moved along the horizontal rod, was used instead of a bullet to disturb the balance.

In making an experiment with this apparatus the secondary coil (B) was first placed within the primary ring and in the same plane with it, and the balancing coil, E, was adjusted to produce silence. The brass ring, C, was then moved along the horizontal rod until the balance was sensibly disturbed and the relative distances of the coils and the brass ring were noted.

Continuing the experiment the coil, B, was moved a determined distance beyond the plane of A, and the balancing coils again adjusted to silence. The brass ring, C, was once more caused to disturb the balance, and the new hearing distance was noted. The following are the tabulated results of a series of experiments made on the 19th of July, 1881.

* I desire especially to express my gratitude to Dr. Frank Hamilton for words of encouragement spoken at a later date when sympathy and encouragement were greatly needed.

The battery employed consisted of six bichromate cells connected in series.

Diameter of Primary Ring.	Distance Between—		
	A B	B C	A C
mm.	mm.	mm.	mm.
	0	17	17
	5	14	19
30	10	13	23
	20	9	29
	30	7	37
	50	0	50
	0	17	17
	5	19	24
50	10	26	36
	20	17	37
	30	14	44
	50	5	55
	0	21	21
	5	23	28
81	10	23	33
	20	18	38
	30	14	44
	50	12	62
	0	22	22
	5	25	30
113	10	27	37
	20	26	46
	30	26	56
	50	17	67

Diameter of Primary Ring.	Distance Between—		
	A B	B C	A C
mm.	mm.	mm.	mm.
	0	27	27
	5	20	25
159	10	18	28
	20	17	37
	30	14	44
	50	14	64
	0	12	12
	5	18	23
206	10	25	35
	20	19	39
	30	22	52
	50	18	68
	0	20	20
	5	18	23
253	10	20	30
	20	19	39
	30	23	53
	50	20	70

These figures show that *the distance from the primary coil,* A (*fig.* 8), *at which the influence of the brass ring,* C, *became perceptible increased with the diameter of the primary ring, and that the secondary coil,* B, *required to be projected considerably beyond the plane of the primary in order to obtain th maximum effect.*

The conclusion seemed a natural one that the degree of projection, A B, of the secondary coil should proportionally increase with the diameter of the primary ring, but the tabulated figures did not fully justify the inference.

The experiments had necessarily occupied a considerable time, and I thought that the difference between the results that should have been observed, according to the above hypothesis, and those that were actually obtained, might have been due to the gradual exhaustion of the bichromate battery employed and to its polarisation, although every care had been taken to preserve its power by removing the carbon and zinc plates from the solution, excepting when an observation was made. To test whether the battery exerted any material influence upon the hearing distance, a further series of experiments was made with the same battery.

It will be seen by reference to the tabulated statement shown above that the maximum hearing distance, B C, had been obtained with a primary ring 11·3 cm. in diameter when the distance, A B, between the primary and secondary coils was one centimetre. This arrangement of the apparatus was, therefore, adopted throughout the following experiments:—

	Hearing Distance: mm.
1. Apparatus tried with 1 cell (bichromate battery) ...	(B C, fig. 8) = 9
2. Six cells in series	(B C, fig. 8) = 16
3. Six cells in multiple arc	(B C, fig. 8) = 9
4. Six cells in two series of 3 each	(B C, fig. 8) = 15
5. Same experiment repeated	(B C, fig. 8) = 13·5
6. Same experiment repeated by Mr. Tainter	(B C, fig. 8) = 12·5

These experiments proved that battery power *did* exert an influence upon hearing distance, and also that the battery in use was gradually deteriorating.

I concluded, therefore, that if the battery power had remained constant, the hearing distance might not only have been proportional to the diameter of the primary ring, but, in order to attain the maximum effect the projection of the secondary coil beyond the plane of the primary might also have been found to increase in like proportion.

This led me to try the effect of a conical primary coil, A, with the secondary, B, at its apex, as shown in fig. 9, but the hearing distance for a bullet was only 3·5 cm.

Singularly enough Mr. J. H. C. Watts, in Baltimore, had independently arrived at a very similar form of coil and with

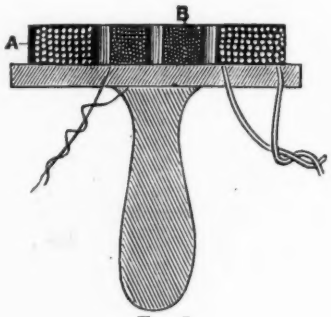


FIG. 7.

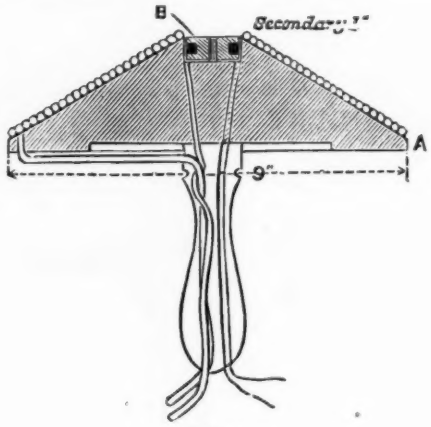


FIG. 9.

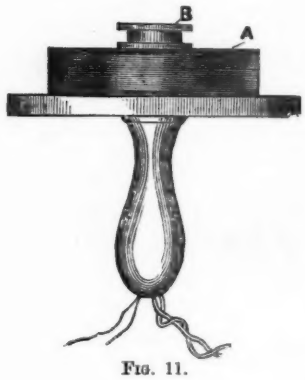


FIG. 11.

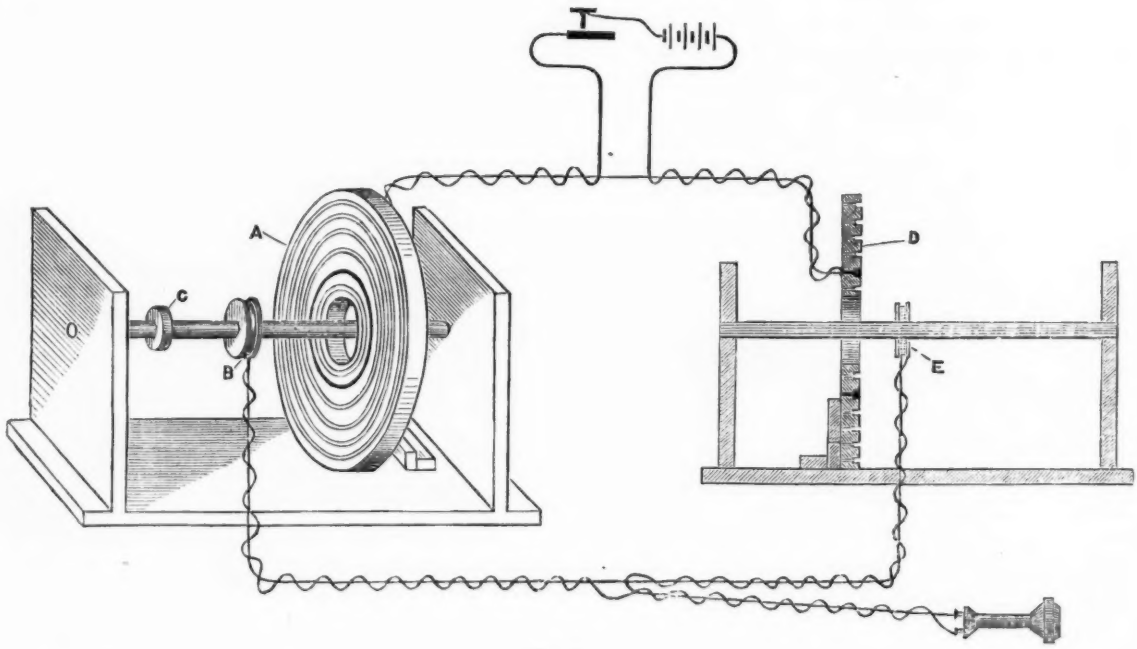


FIG. 8.

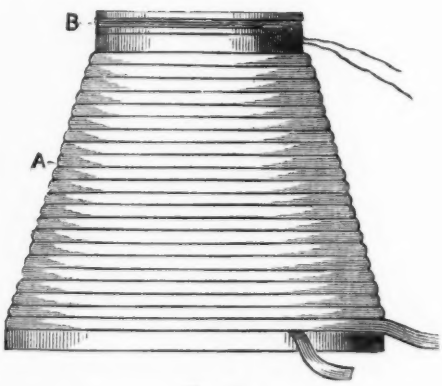


FIG. 10.

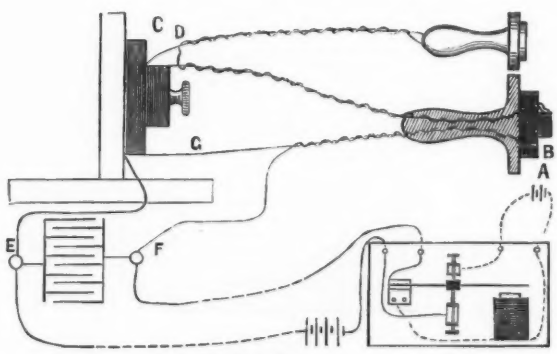


FIG. 13.

Arrangement of apparatus used in the first experiment upon the late President Garfield, July 26th, 1881.

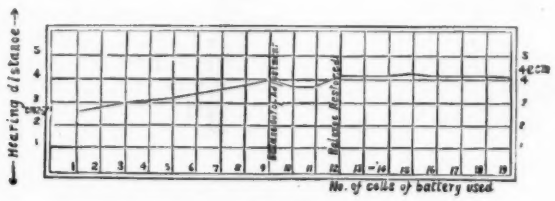


FIG. 12.

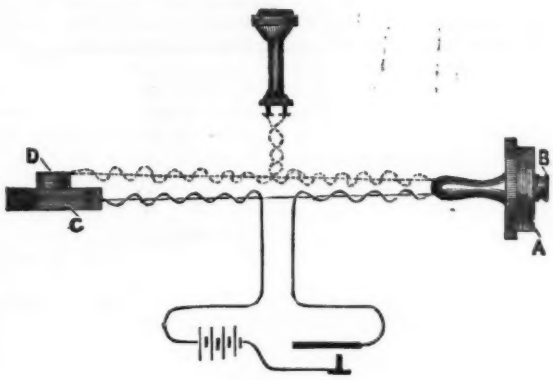


FIG. 14.

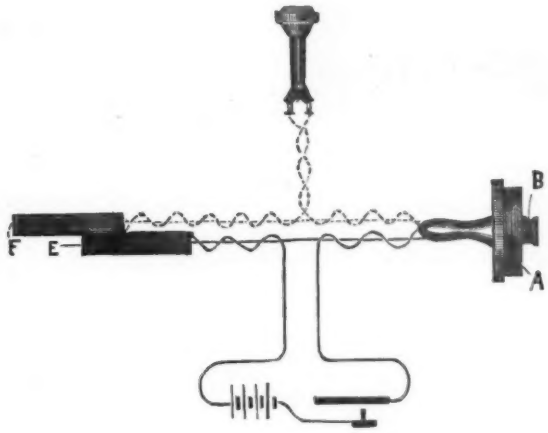


FIG. 15.

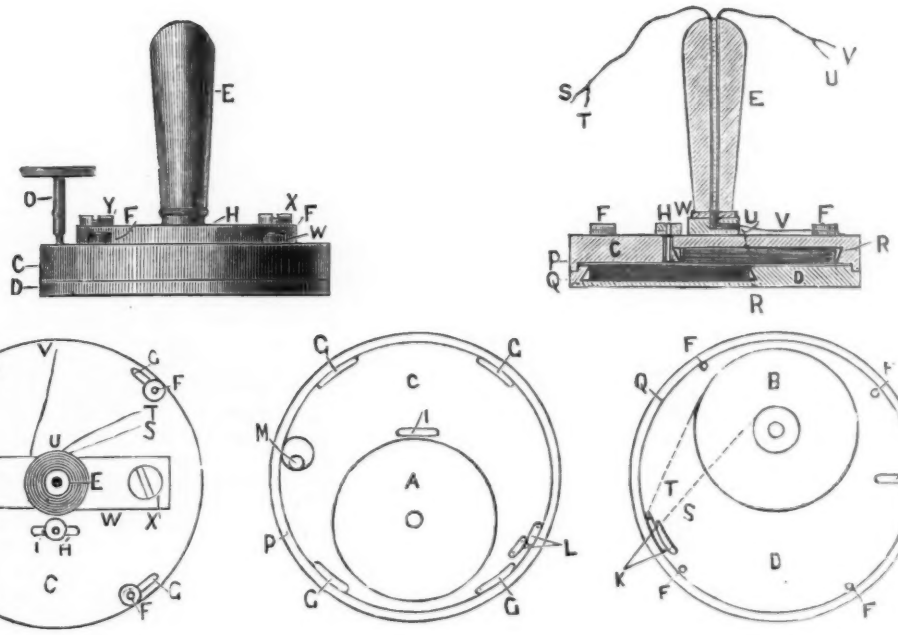
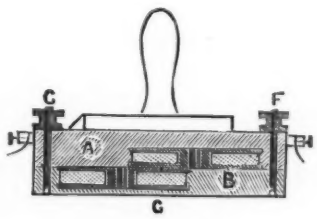


FIG. 20.



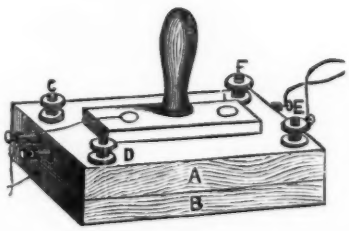


FIG. 18.
Apparatus used in the second experiment upon the late President Garfield, August 1st, 1881.

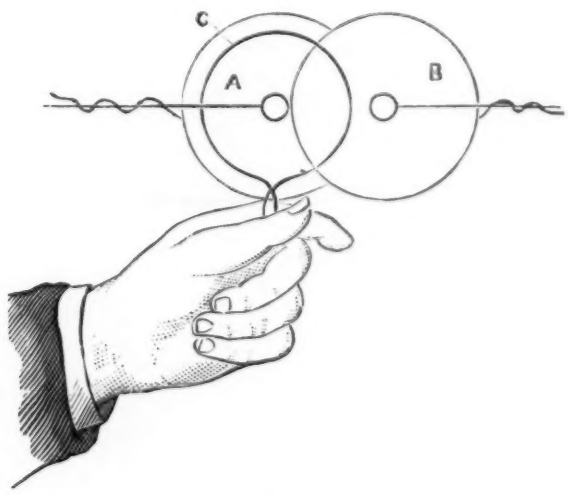


FIG. 19.

the instrument shown in fig. 10 he had obtained at one time a hearing distance of 7·5 cm. (or three inches), but from some cause not ascertained he was unable subsequently to reproduce the effect.

The final form of apparatus adopted as the result of the above experiments is shown in fig. 11. With this arrangement and a battery of six bichromate elements freshly set up, we were always sure of a hearing distance of at least 5 cm., although after the battery had been in use for some time the hearing distance hardly exceeded 4 cm.

The following are the dimensions of the coils A B (fig. 11) and their resistance :

COIL A.....	External diameter	7 cm.
	Internal diameter	4·5 cm.
	Depth	2·4 cm.
Wire used, No. 23 (cotton covered).	Resistance.	2 ohms.
COIL B.....	External diameter	2·3 cm.
	Internal diameter	8 mm.
	Depth	8 mm.
Wire used, No. 36 (silk covered).	Resistance,	75 ohms.

The face of the coil B projected beyond the face of coil A 4 mm.

The balancing coils were made as nearly as possible the duplicates of A and B. The resistance of the coil of the telephone employed was 75 ohms.

Influence of Battery Power.

The following experiments were made with this apparatus (fig. 11) on July 20th, 1881, to test the influence of battery arrangements upon the hearing distance of a leaden bullet.

I.—SERIES OF EXPERIMENTS WITH A BICHROMATE BATTERY WHICH HAD PREVIOUSLY BEEN IN USE FOR A FEW MINUTES.

	Hearing distance of leaden bullet as observed by—	
	A. G. Bell.	S. Tainter.
	cm.	cm.
1 cell	2·4	2·6
2 cells in series	3·3	3·5
3 cells in series	3·7	4·1
4 cells in series	3·7	4·0
5 cells in series	4·0	4·1
6 cells in series	4·3	4·4
6 cells in multiple arc	2·6	2·9
6 cells in two series of 3 each ...— 0 0 / 0 0 / 0 0 —	3·8	3·7
6 cells in three series of 2 each...— 0 0 0 / 0 0 0 —	4·3	4·0

II.—SERIES OF EXPERIMENTS WITH A LECLANCHÉ BATTERY OF TWENTY CELLS WHICH HAD BEEN SET UP FOR ABOUT ONE MONTH. IT HAD BEEN KEPT NORMALLY UPON OPEN CIRCUIT, AND HAD ONLY BEEN OCCASIONALLY USED.

	Hearing distance.
20 cells in series	3·3 cm.
20 cells in 10 series of 2 each	3·6 cm.
20 cells in 5 series of 4 each	4·1 cm.
20 cells in 2 series of 10 each	3·0 cm.

Although the battery appeared to be in good condition, a close inspection showed that the connections were dirty, and that one of the zinc wires was half broken through.

The defective cell was now removed from the circuit and the connections of all the other cells cleansed and tightened.

III.—THE FOLLOWING EXPERIMENTS WERE THEN MADE WITH THE LECLANCHÉ CELLS UNITED IN SERIES :—

No. of cells.	Hearing distance.	No. of cells.	Hearing distance.
	cm.		cm.
1	2·7	11	3·8*
2	2·8	12	4·2
3	3·0	13	4·2
4	3·3	14	4·2
5	3·3	15	4·3
6	3·5	16	4·2
7	3 6	17	4·2
8	3·8	18	4·2
9	4·0	19	4·2
10	3·8*		

* Balance not quite perfect.

These results are graphically represented in fig. 12.

It will be observed that the hearing distance was carried nearly one third as far again as at first, simply by increasing the number of cells employed without any other change in the arrangement. It will also be noticed that the apparatus requires to be adjusted to complete silence in order to obtain the maximum effect.

As a general result of all our experiments with voltaic batteries we find that *it is advisable to use a battery possessing great electromotive force and slight internal resistance, and to connect the cells in series.*

Experiments upon Living Subjects.

On the 22nd of July an experiment was made, at the request of Dr. Bliss, upon the person of Lieut. Simpson, who had carried a bullet in his body for many years.

When the exploring instrument (fig. 11) was passed over the lieutenant's back a sonorous spot was found, but the indications were too feeble to be implicitly relied upon. Imagination very easily conjures up a feeble sound like that observed, but a number of experiments by different observers seemed to indicate that in this case there was an external cause for the sound—probably the presence of a very deeply-seated bullet. The results of this experiment were communicated to Dr. Bliss, in a letter dated July 23rd, 1881.

On the 25th of July Prof. Rowland visited me at Washington and suggested the use of a condenser in the primary circuit. I had previously discussed this idea with Mr. Tainter, but, not having a condenser at hand, we had been unable to make any experiment. After our conversation with Prof. Rowland, however, we were so impressed by the importance of the point that we obtained a condenser next morning, and found it to produce not only a different quality of sound when the bullet approached the coils, but also to increase the hearing distance of the instrument shown in fig. 11 at least one centimetre.

On the evening of the same day (July 26th) our apparatus was carried to the Executive Mansion and an experiment made upon the person of the President.

From some cause then unknown a balance could not be obtained, and the results were, therefore, uncertain and indefinite. It was discovered afterwards that a mistake had been made in the mode of connecting the condenser. The latter should have been connected at E F (fig. 13), whereas it was placed at E G, thus influencing only one, instead of both, of the primary coils.

With the condenser properly arranged experiments were tried on July 29th and 30th on three soldiers from the Soldiers' Home who had been wounded during the Civil War, namely, John Teahan, Asa Head, and John McGill.

In the case of John Teahan no results were obtained. In the case of Asa Head, who had a buckshot in the cheek, loud and well-marked sounds were heard in the telephone ; and in the case of John McGill, who was supposed to carry a bullet in his back, no results were obtained.

Further efforts were then prosecuted for the improvement of the apparatus.

Further Experiments to Improve Apparatus.

Our attention had hitherto been directed chiefly to modifications of the exploring instrument. We now investigated the effect, upon the hearing distance, of the coils used to obtain a balance.

The following experiments, made July 29th, 1881, bear upon the point :

EXP. 1. (See fig. 14.) Resistance of primary, A, of exploring instrument, 2 ohms ; resistance of primary, C, of balancing coils, also 2 ohms ; resistance of exploring secondary, B, 140 ohms ; and of balancing secondary, D, 120 ohms.

Result : Hearing distance of bullet from explorer, A B, 3·5 cm. Hearing distance from balancing coils, C D, also 3·5 cm.

EXP. 2. (See fig. 15.) Same exploring coils as in Exp. 1, but balancing coils consisted of a flat primary, E—resistance, 5·30 ohms ; and flat secondary, F—resistance, 83 ohms. The adjustment was made by sliding the secondary coil upon the primary until a position of silence was obtained.

Result : Hearing distance from explorer, A B, 1·5 cm. Hearing distance from E F, 3 cm.

As a general result of our experiments we found that *every increase in the resistance of the balancing coils (especially the primary) reduced the hearing distance of the exploring instrument*, and it became, therefore, desirable to do away with this source of resistance as much as possible.

Return to Original Form of Apparatus.

This led us back to the original form of apparatus that had first occurred to me (see fig. 1), in which a single pair of coils was employed. A few other experiments, made July 29th, 1881, will show the importance of the point attained.

Exp. 3. The two flat coils, E F, used in Experiment 2 were arranged as in fig. 16, so as to form a balance by themselves.

Result: Hearing distance, 7 cm.

In all these experiments the battery used consisted of four cells (Leclanché).

Exp. 4. The same coils used in Experiment 3 were tried

Fig. 16.

again, as shown in fig. 16, but with a battery of eight cells (Leclanché).

Result: Hearing distance, 8·7 cm., or nearly $3\frac{1}{2}$ inches—a result quite unprecedented in our experiments.

The following are the dimensions of the coils, E F:

Coil E....	External diameter	10 cm.
	Internal diameter	2·5 cm.
	Depth	1 cm.
	Wire used, No. 23, (silk-covered).	
Coil F....	External diameter	10 cm.
	Internal diameter	2·5 cm.
	Depth	1 cm.
	Wire used, No. 28 (silk-covered).	

Exp. 5. The same coils, E F, used in Experiments 2, 3, and 4, were tried once more with a battery of six large bichromate elements, and with a condenser, G, in the primary circuit, as shown in fig. 17.

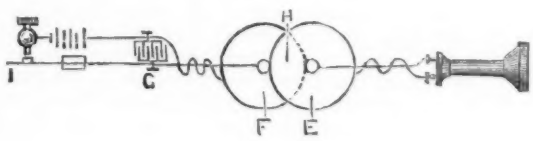


Fig. 17.

Result: Hearing distance 13 cm., or more than 5 inches. This great increase in hearing distance seemed to be chiefly due to the condenser, for upon disconnecting it the hearing distance was little more than 9 cm., but further experiments proved that other causes also contributed to the result.

Exp. 6. When the condenser was in circuit and the leaden bullet close to the coils (arranged as in fig. 17), the sound produced by the telephone was a musical note whose pitch was the same as that normally produced by the vibration of the reed of the interrupter. Mingled with this tone could be distinguished a number of feebler tones of very much higher pitch. Upon withdrawing the bullet gradually from the coils the fundamental sound became fainter, and one of the high upper-partial tones gradually acquired prominence; and at a distance of about 8 or 9 cm. the fundamental could no longer be distinguished, but the high tone persisted, and was clearly audible up to a distance of 13 cm. The effect was very striking, and when the bullet was moved to and fro parallel to the plane of the coils, E F, at a distance of about 10 cm., the telephone emitted a shrill, whistling sound each time the sensitive area (H) was passed.

It was noticed that other metals, such as iron, brass, and copper, did not seem to reinforce this high tone to any great extent, but brought out the fundamental at every distance where an effect was produced.

Exp. 7. The condenser, G (fig. 17), was removed from the circuit and the leaden bullet held about 4 or 5 cm. from the coils, E F. The fundamental tone was heard, and the characteristic upper-partial could also be distinguished, but it was only faintly audible. Upon now suddenly replacing the condenser the high upper-partial tone was instantly reinforced as if by a resonator.

Exp. 8. The rheotome employed to interrupt the primary circuit (which had been placed in a distant room) was found to be vibrating badly. The reed, I, of the instrument (see also fig. 5) was rattling against its contact pieces, thus producing an impure sound, and I could distinguish amongst the upper-partials the tone that had been reinforced by the condenser. Upon screwing up the contact pieces so as to improve the vibration I could no longer distinguish the particular upper-partial referred to, and upon returning to the room in which the coils, E F (fig. 17), were placed I could no longer detect the effects noted above in Experiments 6 and 7, and the hearing distance did not exceed 9 cm.

The peculiar effects obtained with the arrangement shown in fig. 17 *thus seemed to depend* (1) *upon a particular kind of vibration of the reed of the interrupter, producing a certain high upper-partial or overtone,* (2) *upon the use of a condenser acting as a sort of electrical resonator for this tone, and* (3) *upon the use of the metal lead.*

Mr. Marean, of Washington, kindly lent me a number of condensers used by the Western Union Telegraph Co., and we found, upon connecting them with the coils, E F, as shown in fig. 17, and holding a leaden bullet near the coils, that each condenser reinforced a high upper-partial of different pitch. We arranged the condensers so that they could be successively introduced into the circuit with great rapidity. The effect was very curious and sounded somewhat like a Scotch air played upon the bag-pipes. The low hum of the fundamental could be heard continuously, like the drone of the bag-pipe, while the higher tone changed its pitch with each change of condenser.

The pitch of the high tone reinforced seemed to depend upon the electro-static capacity of the condenser employed, but the exact relation between the two has not been ascertained. In Experiments 5, 6, 7, 8, and the subsequent experiments described above, the battery employed consisted of six pairs of carbon and zinc plates of large area placed in a solution of bichromate of potash containing sulphuric acid.

The effects noted above were not produced satisfactorily when the battery was much run down, nor were they obtained with a Leclanché battery which had been set up for some time, but which appeared to be in good condition.

It is evidently necessary in order to produce this characteristic high tone to use a battery possessing considerable electromotive force and slight internal resistance.

Our experiments had reached this stage when, on Saturday, the 30th of July, 1881, I was requested to make another trial upon the person of the President at the evening dressing of the wound.

At this time, however, we had no exploring instruments completed excepting one or two like that shown in fig. 11; for it will be understood that the promising results noted above had been obtained from coils that were simply placed upon a table and adjusted by hand.

We immediately proceeded to the Executive Mansion with the apparatus shown in fig. 13, prepared to make a trial, if it was deemed advisable; but, upon learning of the results of our later experiments, the surgeons resolved to postpone any further trial until we could arrange the coils (fig. 17) in a portable form.

By forced exertions the coils were arranged that same night in a wooden case, as shown in fig. 18. This case consisted essentially of two oblong blocks, A B. A shallow circular recess was turned out in each block for the reception of one of the coils, and the two blocks were held together by four pins of ebonite, C, D, E, F, which passed up through slots in the upper block and were secured by ebonite thumb-screws.

When the instrument was completed I found to my great distress that a balance could not be obtained by any adjustment of the apparatus. There was a position of minimum sound, and the telephone responded to a bullet presented to the central part, G, of the instrument; but the hearing distance did not exceed 3 or 4 cm., whereas we had obtained

with the same coils before the construction of the wooden case a perfect balance and a hearing distance of 13 cm.

After numerous unsuccessful experiments had been made to ascertain the cause of the difficulty, it occurred to me that if two adjoining convolutions in one of the coils made contact at any point, a circuit of low resistance would be formed (a single ring of wire in fact), in which the induced currents might circulate without reaching the telephone connected with the apparatus. I had previously measured the resistance of the coils without discovering any defect, but when I considered the large number of convolutions in each coil it seemed possible that a defect of this kind might exist which could not be discovered by a Wheatstone Bridge, excepting by very delicate and accurate observations. To test whether a short-circuited convolution would produce effects analogous to those observed, a piece of copper wire was bent into an annular form, and the ends connected together. On bringing this metallic ring near a pair of coils, A B, fig. 19, properly adjusted to silence, the balance was loudly disturbed. The copper ring, C, was held as shown in fig. 19, and the balance could not then be restored by any adjustment of the coils. A position of minimum sound was all that could be obtained, and the hearing distance was enormously reduced. This was *prima facie* evidence of the nature of the defect.

The coils (fig. 18) were then removed from their case, but a cursory examination revealed no defect. Upon trial, however (being arranged as formerly in fig. 17), a balance could not be obtained, and the hearing distance was only about 4·4 cm. The defect was thus definitely located in the coils themselves.

Upon close examination it was noticed that the outside convolutions of the primary coil were slightly frayed at one part, but it appeared hardly possible that so great a defect could be due to so apparently slight a cause. However, to test the matter, I removed the outside layer of wires and then tested the coils result again.

Result: The defect had vanished—a perfect balance was obtained, and the hearing distance was again 13 cm.*

The coils were then replaced in their case, and the completed instrument tested. The lower wooden block, B (fig. 18), was adjusted by hand as nearly as possible to the position of silence, and then the thumb-screws, C, D, E, F, were tightened.

The balance now obtained was not quite perfect, but by striking the lower block, B, a few smart blows with a wooden mallet we were able to reduce the arrangement to complete silence.

The instrument was then in such a sensitive condition that it could scarcely be moved without affecting the balance. Upon gently swaying it backwards and forwards a pulsation of sound was heard at every swing.

When the motion was carefully made, so that it was always in the same place, no pulsations were observed. They only occurred when the inclination of the coils was changed.

This defect was found to be due to the bulging of the thin portion, G, of the wooden case (fig. 18) under the weight of the enclosed coil, and the simple pressure of a finger on this portion of the case disturbed the balance. The movement of the lower coil when the instrument was swayed about must have been inconceivably small, but on account of the extreme sensitiveness of the arrangement, it produced a perceptible effect upon the balance.

The pulsating sound did not seem to interfere with the detection of a bullet held in the clenched hand, nor did it seem to affect the hearing distance. I therefore despatched a messenger to the Executive Mansion (Sunday morning, July 31st), with a note for Dr. Bliss, to let him know that the instrument was in a condition to be used, should any necessity arise for an immediate experiment. At the same time I informed him that the apparatus in its present form was very crudely constructed, and that I hoped to improve it very greatly in the course of a few days. On Sunday afternoon (July 31st) we sent to the Soldiers' Home for John McGill, upon whom we had experimented the previous day without results (using the apparatus shown in fig. 11).

Upon trying the new instrument (fig. 18) we had no difficulty in finding a sonorous spot in his back, at the place where the bullet was always supposed to be.

This result was at once communicated to Dr. Bliss, and in reply we were requested to make the experiment upon the person of the President next morning.

On Monday morning (August 1st, 1881,) we accordingly removed our apparatus to the Executive Mansion.

The Late President Garfield.

During the former experiment (July 26th) a sudden sonorous effect had been observed upon passing a point near the spot where the surgeons suspected the bullet to be lodged, but I had been unable to verify this by a second observation, although the exploring instrument (A B, fig. 13,) was repeatedly passed over the same place. The sound had been so loud and well marked that I believed at the time it must have been caused by a sudden irregularity in the vibration of the reed of the rheotome used to interrupt the primary circuit, for the arrangement (as explained before) was not perfectly balanced, and any irregularity of this kind would, under these circumstances, have affected the telephone. At the same time the coincidence was remarkable that the exploring instrument should have been at that very time so near the suspected seat of the ball, and this led to the thought that perhaps after all the bullet had been the cause of the sound. I felt confident that the new instrument (fig. 18) would at once decide the question, for the extreme hearing distance of the former apparatus (fig. 13) was only 6 cm., and the apparatus shown in fig. 18 was so superior in this respect that if the sound had really been due to the bullet we should obtain with the new instrument distinct and well-marked effects. When the new explorer (fig. 18) was passed over the suspected spot nothing was heard excepting a slight pulsating sound as the instrument was moved to and fro. This was evidence to me that the former sound had been of accidental origin, whether the bullet was there are not. With the view of eliminating any error of observation caused by the pulsations due simply to the movement of the instrument, I lifted the latter (without changing the inclination of the coils) to a height of about 50 centimetres above the body of the President, and moved it to and fro in as nearly as possible the same way I had done at the lower elevation.

I presumed that if the pulsations heard were due simply to the movement of the instrument, they should occur with equal strength at the two elevations; but if any portion of the sonorous effect was due to the influence of the bullet, the pulsations at the two elevations would be different in intensity. I was struck by the fact that, although the sonorous pulsations were very feeble, they were sensibly louder when the instrument was close to the surface of the body than when it was raised. Continuing the exploration, I found a considerable area over which similar effects were noticed, but upon carrying the instrument towards the back of the President, the difference between the pulsations produced at the two elevations grew less and less, and finally could not be distinguished.

The difference in the loudness of the sound at the two ele-

* These experiments have revealed the cause of the extreme difficulty always experienced in obtaining a perfect balance with coils of fine wire. I have recently used an induction balance to test the condition of the helices that were employed in these researches, and discovered that in a large percentage of cases the insulation was defective. It is possible that some of the results described in this paper (especially of the earlier experiments) may have been vitiated by errors due to defects in the coils that were not suspected at the time. A defect of insulation that is quite immaterial for ordinary purposes may be absolutely fatal to the success of an induction balance. Indeed, so much care is required in this respect that it is extremely difficult to obtain coils that are perfectly suitable for an apparatus intended to search out a bullet embedded in the body. I now make it a rule to test every helix used in induction balance experiments by bringing it up to a system of balanced coils like that shown in fig. 17.

1. If the helix is perfect the balance is not disturbed until the terminals of the coil are connected.

2. If there is a break in any of the convolutions the balance is not disturbed, even when the terminals are connected.

3. If a convolution is short-circuited the balance is disturbed, even though the terminals are not connected, and the sound produced is the fundamental of the rheotome employed to interrupt the primary circuit.

4. If the insulation is defective the balance is disturbed, although the terminals are not connected, and a peculiar spluttering effect is noticed like that produced by a series of sparks.

I propose to apply this method practically as a means of testing the condition of the helices used in the construction of induction coils and those employed in the manufacture of telephones.

vations was so slight that it probably would not have been noticed by an ear unaccustomed to listen to feeble effects, and I feared that the general expectation that the bullet would be found in that part of the body might have led me to imagine a difference that did not exist. For the purpose of eliminating as far as possible any personal error, I requested Mr. Sumner Tainter (who was the only other person present whose ear had been sufficiently trained to be reliable in such an emergency) to repeat the experiments and let me know the result. Upon our return to my laboratory we compared notes, and I found that his observations tallied with mine. He declared he could not obtain a distinctly localised effect, but stated that he had observed a reinforcement of the pulsation over an area of at least two inches in the neighbourhood of the spot to which his attention had primarily been directed, and that he was convinced that the bullet was within that area.

It appeared reasonably certain that the area of feeble sound was due to some external cause, and was not simply an effect of expectancy. In the absence of any other apparent cause for the phenomenon I was forced to agree in the conclusion that it was due to the presence of the bullet, and I so stated in my report to the surgeons. I was by no means satisfied, however, with the results obtained, for no such effects had been observed before in our experiments with bullets. I tried to reproduce the effects by moving the instrument (fig. 18) at different distances over a bullet, but in every case where an effect was produced the sound was quite sharply localised. I thought that perhaps the body of the patient might have affected the result, and so experimented upon a bullet buried in a piece of meat, but no difference of effect was noted. This led me to fear that the extensive area of feeble sound might have been due to some extensive area of metal that was unsuspected at the time, and I proceeded to the Executive Mansion next morning (August 2nd) to ascertain from the surgeons whether they were perfectly sure that all metal had been removed from the neighbourhood of the bed. It was then recollected that underneath the horse-hair mattress on which the President lay was another mattress composed of steel wires.

Upon obtaining a duplicate, the mattress was found to consist of a sort of net of woven steel wires, with large meshes. The extent of the sonorous area having been so small, as compared with the area of the bed, it seemed reasonable to conclude that the steel mattress had produced no detrimental effect.* I was unable to continue experiments with the steel mattress, as just at this time I was obliged to leave Washington on account of illness in my family. Although I was unable for a long time afterwards to carry on personally Induction Balance experiments, the investigations were ably continued under my direction by Mr. Thomas Gleason, in the establishment of Mr. Charles Williams, Jun., in Boston.

Experiments continued in Boston.

Mr. Tainter forwarded from Washington drawings of an improved apparatus he had designed to remedy the defects of the instrument shown in fig. 18, in which the case, adjusting screws, &c., were all to be composed of ebonite.

Mr. Gleason constructed for me a number of such ebonite instruments differing slightly from one another in detail, and the apparatus shown in fig. 20 combined the different points that had been approved.

The two coils, A B, were eccentrically arranged in two circular discs of ebonite, C D, and the adjustment was obtained by means of an ebonite key, O, like the key used for tuning pianos, which turned a cam, M, pivoted in the upper disc and working in a slot, N, in the lower disc.

In order to prevent any movement of the coils, excepting that produced by the adjusting-key, O, each coil was placed in a recess turned out in its ebonite disc, the edges of which were bevelled as shown at R. Paraffine was then poured in so as to fill up each recess. But this alone did not prevent a slight pulsation of sound when the instrument was swayed from side to side, and a very slight pressure of the finger on the thin portion of the ebonite plate under the coil, B, was sufficient to destroy the balance.

This was remedied by strengthening this portion by means of a rod of ebonite which passed up through the centre of the coil and through a slot, I, in the upper ebonite plate, and was clamped firmly after the adjustment of the instrument by an ebonite thumb-screw, H. This, however, increased the difficulties of adjustment. When the coils were adjusted to silence, then the tightening of the thumb-screw, H, disturbed the balance; and if the thumb-screw, H, was tightened first, then the adjustment could only be made by a series of jerks on account of friction. In practice we found it best to adjust the instrument *almost to silence*, and then the tightening of the thumb-screw, H, completed the balance.

This was the form of apparatus at which we had arrived at the time of the death of President Garfield.

The difficulty of adjusting the coils led me ultimately to the idea of the apparatus shown in figs. 21, 22, 23, 24, which is the most practical form of the instrument yet devised.

The two exploring coils, A B (fig. 21), are arranged as

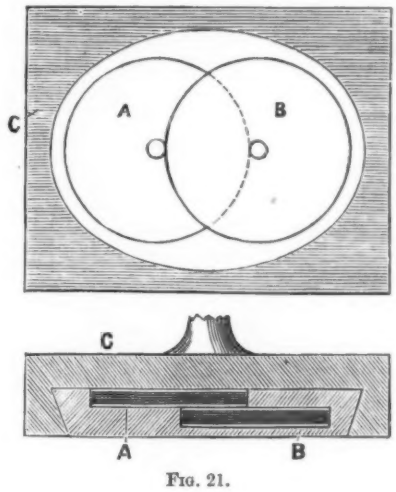


FIG. 21.

shown, in a recess turned out in a single block of wood, C.

The coils are temporarily connected with a telephone, battery, and rheotome in the manner shown in fig. 1, so that they may be adjusted by hand to form a balance. When they have been arranged in their position of silence the hollow in the block of wood, C (fig. 21), is filled with melted paraffine. Upon cooling, the two coils are found immovably fixed in one solid cake of paraffine.

As a matter of practice it is found impossible to fix the coils in this way exactly in their position of silence; but by means of two other very small coils, D E (fig. 22), of insigni-

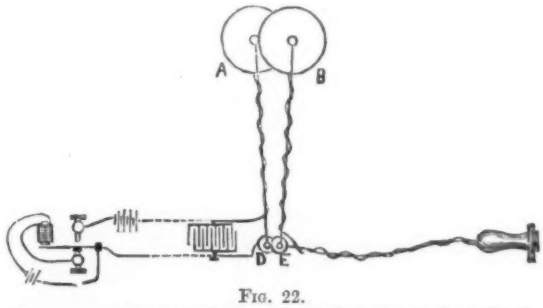


FIG. 22.

Apparatus with which the location of the bullet in the body of Col. Clayton was discovered, October 7th, 1881.

ficant resistance, forming a sort of fine adjustment external to the explorer, a perfect balance is easily obtained. In this instrument the swaying of the coils, A B, produces no effect upon the balance.

The completed arrangement is shown in plan in fig. 22, and the explorer and balancing coils are shown separately in perspective in figs. 23 and 24.

On account of the small size and slight resistance of the balancing coils, we were enabled to make the adjustable parts of the balancer of metal without practical interference

* The death of President Garfield and the subsequent *post-mortem* examination, however, proved that the bullet was at too great a distance from the surface to have affected our apparatus.

with the sensitiveness of the exploring instrument, and this gave us the power of making very delicate adjustments of the balancing coils.

We found it advisable, however, to avoid placing metal over the sensitive area of the coils, as had been done in the instrument shown in fig. 24.

FIG. 23.

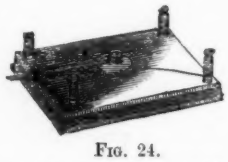


FIG. 24.

In the balancing apparatus shown in fig. 25 (which is the most perfect one yet constructed), the lever to which the upper coil is attached is made of hard rubber.

In fig. 26 is shown the most convenient form of case yet devised for holding the exploring coils.

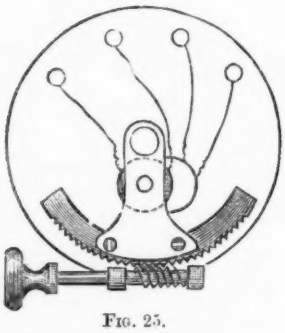


FIG. 25.

By invitation of Dr. Frank Hamilton, experiments were made with it at his office in New York, October 7th, 1881, the instruments used being those shown in figs. 22, 23, 24.

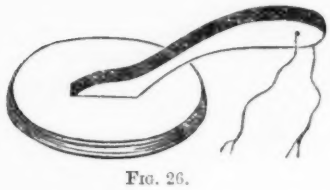


FIG. 26.

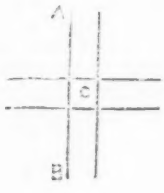


FIG. 27.

As this was the first successful application of the Induction Balance to the discovery of the situation of a ball in the body, the position of which was previously unknown, I may be pardoned for entering somewhat into detail.

I shall quote from the *Medical Gazette** of NewYork an account of the experiments, written by one of the witnesses :

The First Successful Application.

On Friday, October 7th, by invitation, several medical gentlemen,† including the writer, met Prof. Bell at the house of Dr. Frank H. Hamilton, in this city, for the purpose of witnessing the practical application of his improved instrument.

The first person subjected to experiment was General Calvin E. Pratt, judge of the supreme court of the State of New York, and who is now a resident of Brooklyn. General Pratt, at the battle of Gaines' Mills, June, 1862, this being the second day of the famous seven days' retreat across the peninsula, received a ball in his left cheek, which penetrated through the nares and was lodged in the right antrum. Its presence at this time was recognised by his surgical attendant, Dr. Damainville, and its exact position has been known from that day until this, it having given rise at times to much pain and suffering.

General Pratt has been seen by Dr. Hamilton and Dr. Damainville occasionally from that time forward, and they have from time to time urged upon him the necessity of its removal. General Pratt, however, was anxious to know whether Prof. Bell's instrument would indicate its presence at the same point as declared by his surgeons.

The results of the experiment were conclusive and entirely satisfactory to General Pratt, the response being heard distinctly, but rather feebly, by every person present in the room. The feebleness of the response was supposed to be due to the fact that, owing to its situation and the peculiar form of the instrument containing the induction coils, it was impossible to bring the centre of its surface very near the site of the ball, the ball being situated very near the depression at the ala of the nose.

The next patient was Col. B. F. Clayton, who received a wound at the battle of Cedar Mountain, Virginia, Aug. 9th, 1862.

The missile was supposed to be an Enfield rifle ball, and the wound was supposed to be mortal by the medical director of General Banks' staff and his assistants. The ball passed through the sternal end of the left clavicle, and was supposed to have lodged in the muscles under the superior angle of the corresponding scapula. The injury was followed by complete paralysis of the left arm, continuing for a period of six months; and his arm has never yet been completely restored to its normal condition. He suffers a great portion of his time from pains in the arm, shoulder, and portions of the back.

Several small fragments of bone escaped through a fistulous orifice formed near the seat of the original wound.

About eighteen months later an abscess opened on the front of the chest below the fifth rib and to the left of the sternum. Through this sinus his surgeon was able to carry a probe upwards and backwards towards the top of the shoulder several inches, and which sinus was supposed then to communicate with the seat of the ball on the back.

Pleural adhesions were recognised by the medical attendants as having occurred in the upper part of the left thoracic cavity. He has been troubled occasionally ever since the injury with cough, expectoration, and violent palpitations of the heart. A suspicion has even been entertained that the fistulous canal which remained open a period of eighteen months, and then became permanently closed, communicated with the bronchial tubes, but at no time was a suspicion entertained by him or his medical attendants that the ball was not lodged in the back and there closely encysted.

We are disposed to mention as an evidence of Col. Clayton's loyalty and faithfulness as a soldier that within six months of the receipt of the injury, and while the wound was still discharging pus and blood, he returned to active duty with his regiment and remained in the field until the close of the war.

In the presence of the gentlemen assembled Col. Clayton exposed his chest, and Prof. Bell proceeded to move the coils across that portion of his back where the ball was supposed to be situated, the colonel indicating the point underneath the superior angle of the scapula as that which had been fixed upon by himself and all the surgeons who had examined him as its exact seat. Although being buried underneath the scapula, they had not been able to verify their diagnosis by the sense of touch. Repeated examinations were made over this region without any response both by Prof. Bell and several of the gentlemen who were present.

The instrument was then moved in every direction across the back and shoulders with the same result. There was an evident feeling of disappointment on the part of Prof. Bell and all the gentlemen present, for no one entertained a doubt up to this moment that the situation of the ball was known and correctly stated by Col. Clayton.

It was not until the lapse of half an hour, and a thorough examination on the part of Prof. Bell to determine if there was not some imperfection in the working of the apparatus, that it was suggested to move the instrument along the front of the chest.

This was done by Prof. Bell, and immediately he exclaimed, "I have found it!" And such was evidently the fact, as was verified by the personal examination through the telephone by every gentleman present. The response when the instrument was moved over the seat of the ball was loud and distinct, and left no room for doubt.

After all the visitors present had had the opportunity of verifying my discovery of the sonorous spot on the chest of Colonel Clayton, experiments were made to determine as accurately as possible the exact position of the ball.

The exploring instrument (fig. 23) was first held over that part of the chest where the maximum sound was obtained. The instrument was then moved slowly towards the left, until the sound could no longer be perceived. The position of the centre of the instrument was noted, and a vertical line, A B, fig. 27, was drawn with ink upon the skin through that point. This line indicated the boundary of the sonorous area towards the left. The experiment was then repeated by moving the instrument from the point of maximum sound towards the right, and also upwards and downwards, giving us the four boundary-lines shown in the diagram (fig. 27). The bullet was thus located within a square, C, of about one inch.

The exact situation of the ball, as described in the *Medical Gazette*—

Was found to be within the thorax, probably in immediate contact with the inner surface of the ribs, the point being a little to the left of the sternum, between the third and fourth ribs, and two or three

* See *Medical Gazette*, October 15th, 1881, pp. 347-349.

† The following are the names of the medical gentlemen who were present, each one of whom verified personally the results and declared his entire satisfaction with every experiment that was made: J. C. Hutchinson, J. G. Johnson, and J. G. Allen, of Brooklyn; Elias Marsh, of Patterson, N.J.; Nathan Bozeman, J. H. Hunter, G. Durant, F. Delafield, L. Damainville, W. M. Chamberlain, J. H. Girdner, Frank H. Hamilton, and E. J. Bermingham, of New York.

inches above the cicatrix on the front of the chest, where the sinus, long since closed, had evacuated itself, and in a direct line from this cicatrix towards the left shoulder, which indicated the line of the track of the original sinus.

Experiments with Needles.

During my absence from Washington and from all conveniences for experimenting personally with Induction Balance apparatus, I devised a method of verifying the indications of the Induction Balance and of ascertaining the exact depth at which a bullet lies beneath the surface. This method was communicated through Dr. Woodward to the surgeons in attendance on President Garfield, and it was made the subject of a special paper presented to the French Academy of Sciences November 7th, 1881.

This method, although involving extremely slight pain, would ordinarily be used only as a preliminary to an operation for the extraction of a bullet. The arrangement is shown in fig. 28. A fine needle, A, is connected to one ter-

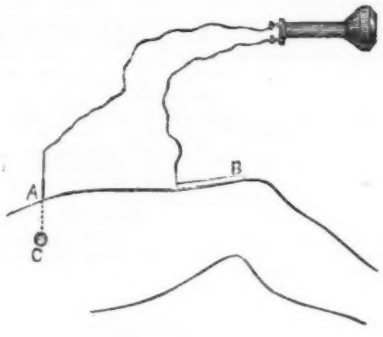


FIG. 28.

minal of a telephone, and the other terminal makes contact with a plate, B, preferably of the same material as that composing the needle. Place this metallic plate, B, against the surface of the patient's skin and thrust the needle into that portion of the body where the bullet is believed to be lodged. When the point of the needle makes contact with the surface of the bullet, C, a galvanic battery will be formed naturally within the body, the two poles of which are respectively the leaden bullet, C, and the metallic plate, B. Under these circumstances a click will be heard from the telephone each time the bullet is touched by the needle. This has been verified by experiments upon bullets buried in a joint of meat. The click, though feeble, is unmistakable.

I have no doubt that this method of exploration alone, without the induction balance, would prove of great service upon a field of battle, where the employment of complicated apparatus is impossible. Mr. Thomas Gleason has recently communicated to me the particulars of an experiment he witnessed, in the course of which this method was tried upon a living subject. The surgeon who conducted the experiment was unable to obtain any response from the induction balance employed, although from certain indications apparent to the sense of touch he believed that the bullet was located in the part of the body submitted to experiment.

To verify his supposition a needle, connected as above (fig. 28), was thrust into contact with the hard substance perceived, but no response was made by the telephone. The surgeon, however, believing that the bullet had been found, etherised his patient and proceeded with an operation, but discovered, when too late, that the bullet was not there.

Further Modifications of Induction Balance.

I sailed for Europe early in October, 1881, and have had no opportunity since of continuing my researches until quite recently. While I was in Europe, however, Mr. Sumner Tainter devised a new kind of Induction Balance which deserves mention here. The results obtained with this apparatus in its present form (fig. 29) are not to be compared with those produced by the best instruments described above, but there are undoubtedly great possibilities of future development.

The important feature is that the exploring instrument, E, consists of *a single coil*, so that there is no possibility of any part of the explorer getting out of adjustment. All the adjustments are made upon the stationary part of the apparatus.

The current of the battery is divided between two equal circuits. One of the primary circuits contains the coil, A, and the exploring coil, E, and the other circuit the coil, C, and a rheostat, R. Coils A and C are exactly similar; and

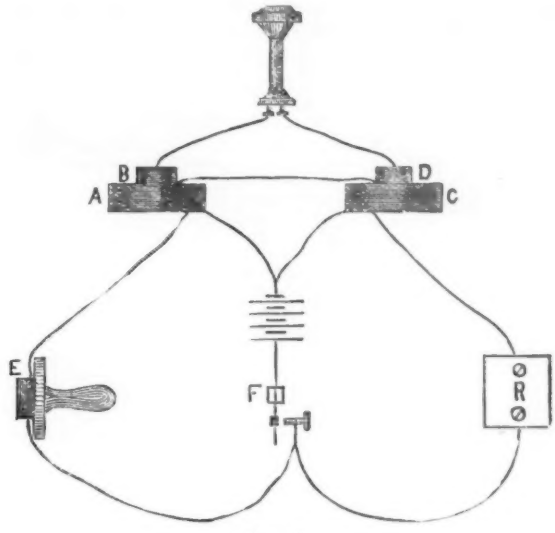


FIG. 29.

if the resistance introduced at R is equal to the resistance of the exploring coil, E, an acoustic balance can be obtained by the adjustment of the secondary coils, B D, upon the primaries, A C; but if the resistance introduced at R is different from that at E, Mr. Tainter states that no balance is possible.

When the apparatus is adjusted to silence the approach of a bullet to the coil E destroys the balance.

Although the great object of the researches that have been brought before you to-day has been to find that arrangement of balance which will detect a bullet at the greatest distance from the coils of the explorer, it must not be forgotten that in every case the instrument is more sensitive to the presence of a bullet placed *inside* the exploring coils than to one exterior to them. When, therefore, we seek the location of a bullet in one of the limbs, it may be advisable to use an annular coil large enough to slip easily over the leg or arm, as the case may be.

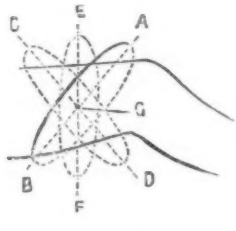


FIG. 30.

In Mr. Tainter's arrangement the exploring coil, E (fig. 29), might simply be a large ring consisting of a number of convolutions of thick wire, which could be slipped over the limb, or the ring might consist of two coils, forming one side of a Hughes Induction Balance.

In either case the loudest sound will be produced when the bullet is in the plane of the ring, and its exact location should be deduced from three observations. Suppose, for instance, that with the ring inclined in a particular direction the maximum sound is obtained when the ring occupies the position, A B (fig. 30). We know then that the bullet is in that plane. Now, incline the ring in some other direction and explore again. Let the position of maximum sound be now C D. We know then that the bullet is somewhere on

the straight line formed by the intersection of the planes, A B and C D. It is only necessary then to make a third observation with the apparatus so inclined that the plane of the ring cuts this straight line, for instance, the position, E F. The point of intersection of the three planes, G, is then the exact point occupied by the bullet.

I shall conclude this paper by the description of an experiment made in Newport, R.I., a few days ago. The results are so unprecedented in my experience that I feel they cannot be received as implicitly reliable until the experiments have been repeated and verified.

I had arranged upon a table three coils (as shown in fig.

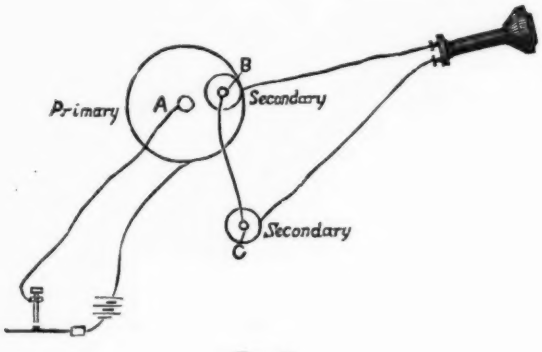


FIG. 31.

31). The large flat primary coil, A, was connected with a battery of four Bunsen elements and an interrupter, as shown, and the two small secondaries of fine wire, B C, were connected with a telephone.

The secondary, B, was moved about on the primary, A, until a position of silence was obtained. Upon bringing a leaden bullet near C the balance was disturbed and a distinct sound produced from the telephone. There is nothing very strange about this when we know that the distance between A and C was only 15 centimetres, so that C was well within the field of induction of A; but what did seem extraordinary was that the approach of the large steel blade of a penknife to the coil, C, produced no effect. The iron diaphragm of a hand telephone brought close up to the coil, C, produced no sensible disturbance of the balance, whereas a small disc of lead produced quite a marked effect. A disc of copper the size of a telephone diaphragm also produced a good effect, but the sound was not sensibly louder than that due to the small leaden disc. A diaphragm of zinc occasioned a feeble but distinct disturbance of the balance. It is unfortunately the case that in all the forms of induction balance described above lead gives the poorest effect of all metals. If people would only make their bullets of silver or iron there would be no difficulty in finding them in any part of the body. In the apparatus shown in fig. 31, however, it seems (unless subsequent experiments should reveal some fallacy) that we have an arrangement which is sensitive to lead and not to iron, or, at all events, which is more markedly influenced by lead than iron.

It is hardly necessary to state that when the coil, C, was removed to a considerable distance from the primary, A, no effect was produced by the approach of metal to the coil, C.

I have in this paper brought before you an outline of a labour of love pursued through many anxious days and sleepless nights. However imperfect or disappointing may be the results so far achieved, they are sufficiently encouraging to enable us to look forward with confidence to the attainment of still greater perfection.

I hope to continue these researches in the future; and certainly no man can have a higher incentive to renewed exertion than the hope of relieving suffering and saving life.

EARTH CURRENTS.—A correspondent, writing from the Orange Free State, informs us that on the 17th November great trouble was experienced on the telegraph circuits through earth currents, which he had never before known so powerful.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

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ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I should esteem it a favour if you would insert in your journal a few observations that I feel called upon to make on an article dated December 16th, entitled: "Electrical Engineering Classes." I should not have thought of answering a letter the writer of which had not the courage to sign his name, if I had not found in it a flagrant injustice, directed not only against one of my professors, but against the City and Guilds of London Institute as a whole.

The gentleman who signs himself "One who Wishes to Learn" has not chosen an inappropriate *nom de plume*, for he really has a great deal to learn, since he has not been able to follow Professor Ayrton's clear and interesting course; only, it seems to me that such a pupil is not very competent to form an opinion on the lines followed by one of his professors. However that may be, our zealous student goes still farther; not content with attacking his professor in the most irreverent manner, he proceeds to criticise, with truly inconceivable lightness, the whole organisation of the City and Guilds of London Institute. According to him, the institute is wanting in system, the professors and their assistants in zeal, the laboratory in apparatus and instruments! *O tempora! O mores!* if this were really the case. But fortunately it is not so, and if the writer had tried to deserve the name he assumes he would perhaps have become acquainted with the system and the method observed at the course given at the institute which has *condescended* to receive him.

It would be easy to prove to Mr. X or Y, no matter which, that perfect harmony reigns in the courses given by the professors of the institute; every pupil can, by running through his notes, convince himself of the truth of my assertion; and will feel compelled to acknowledge that all the efforts of his professors are directed to the same practical end. I have travelled somewhat, and have examined attentively numbers of schools and institutes of repute on the continent; I can compare them and form an impartial judgment of their merits, and am not afraid to say, that by its method and practical tendency, and the zeal of its professors and assistants, the City and Guilds of London Institute can vie with the best schools in Europe.

CH. AUG. NUSSBAUM.

ELECTRICAL INSTRUCTION.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Somewhat to the westward of Wardour Street is a place for the above, as to which an inquiry is made in yours of the 16th December. I know the place well and therefore do not name it.

For practical teaching in electrical engineering I should recommend your subscriber to keep to the eastward of the interesting street I have mentioned.

As one who knew what he was talking about observed recently, "Science is becoming quite an Art," and even though your correspondent's quest be connected with electricity, you will, I believe, agree with me that he cannot be advised to forget the old maxim,

CAVEAT EMPTOR.

ELECTRO-MOTORS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—As Mr. Moritz Immisch has obviously not quite grasped the meaning of several points in my recent lecture at the Society of Arts I am sorry that he has not waited for the appearance of the printed lecture in the Society's Journal before ventilating his difficulties, some of which would, I think, have disappeared on further consideration. Pending the publication of the full text in the Society's Journal I would rather be excused from entering upon the many points raised by Mr. Immisch. But as one of them is somewhat outside the range of my lecture I may perhaps deal with it.

I think Mr. Immisch makes the mistake of confounding together the efficiency of a motor *per se* (*i.e.* the ratio of the mechanical power it performs to the electrical power it absorbs) with the efficiency of a system for transmitting power by electricity, which system includes a generator at one end of the line and a motor at the other. Now, suppose that at each end of such a line we place a dynamo of very perfect construction, such, for example, that each would have in itself an *efficiency* of 90 per cent.

If everything is arranged in the best possible manner then the greatest possible theoretical efficiency of the combination is 81 per cent. For the generator will turn 90 per cent. of the mechanical power into electrical power, and 90 per cent. of the electrical power so transmitted will be reconverted by the motor into mechanical power. Now the point at which Mr. Immisch stumbles is, that the efficiency of a system never attains this theoretical value (namely, the product of the separate efficiencies of the two machines) unless the motor runs at so high a speed as to annul the current sent from the generator. He does not seem to comprehend that efficiency is a *ratio*, not a concrete quantity, and that this ratio has its highest theoretical value when both the concrete quantities composing it have indefinitely small values. But let him reflect that if there is a strong current running through the system there will be heat waste; which necessarily implies that the whole of the electric power is *not* being converted into mechanical power by the motor. Again, it must be quite evident that the efficiency of a system is different from that of the motor *per se*. Suppose the dynamo used as generator to be a small one of 90 per cent. efficiency and high electromotive force, but suitable only for working up to, say, one horse-power. Let the machine used as a motor be, let us say, a heavy electroplating dynamo, also of 90 per cent. efficiency and of 10 horse-piower. Will any one who knows anything about dynamos or motors suppose that such a system can by any possibality work with an efficiency of 81 per cent.? On the contrary it will be about as inefficient as could be contrived. My lecture gave the reason why in the very theory which Mr. Immisch disputes.

I must therefore ask Mr. Immisch whether, when he has confused the efficiency of a single machine with the efficiency of a system working together, he is quite in place in attempting to discredit the suggestions relative to the construction of motors thrown out in my lecture. "It seems to me unlikely," says Mr. Immisch, "that rules and standards for comparing relative merits of motors can be constructed upon foundations such as this." It would have been better if Mr. Immisch had not mixed up rules and standards for comparing the relative merits of motors with the rules and theories for comparing the relative merits of systems. I do not mind his discrediting my motor, and saying it is inefficient: for I can prove him wrong, if he is wrong. I do not mind his discrediting my theory of transmission of power by a system, because my theory is not mine, but is simply mathematical reasoning, capable of being experimentally proved. But I do object to Mr. Immisch saying, in effect, that because he can't comprehend my theory of transmission of power by a system, that therefore my rules and standards for the merits of motors are not to be trusted.

Lastly, I will put one point to Mr. Immisch. He says that when the motor was allowed to run "the current itself, as measured by a current-meter," was "necessarily falling off." Now, a falling-off in the current could only arise from one of two causes, either from an increase in the resistance of the motor, or from an opposing electromotive force in the motor itself. Which does Mr. Immisch suppose it to be? He surely ought to have made the tests necessary to convince himself which it is, in the case of his own motor, before he rushes into print with criticisms on the theory of motors in general.

I am, dear Sirs, yours faithfully,

SILVANUS P. THOMPSON.

[This letter from Prof. Thompson renders it quite unnecessary that we should reply to Mr. Immisch.—EDS. ELEC. REV.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—In perusing your interesting report of the Proceedings of the Society of Telegraph Engineers and of Electricians I was somewhat disappointed to find that the question of supplying provincial members of the society with books from the library had again passed unnoticed.

As we are shortly to have the Parcels Post in operation, it cannot surely be difficult to arrange for those who do not reside in London enjoying the advantages of so valuable a library. The books might be sent direct to the applicant, or in the case of large towns where there are many members, let one be appointed to act as local secretary, to whom all applications for books should be addressed, and through whom all books should be issued and returned.

The few pence incurred for transmission would be ungrudgingly paid, and the society would gain by an increased membership, a larger sale of catalogues, and by the deepened interest of its members.

Thanking you in prospective for the insertion of this note in your excellent journal,

I am, yours truly,

FAREHAM.

THE INSTITUTE OF PATENT AGENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your article on the Institute of Patent Agents you speak of the names of the Fellows being a guarantee of efficiency. But is it not, to say the least, surprising that a body of gentlemen who are to sit in judgment upon the qualifications of others should not have been called upon to give some more substantial proof of their own qualifications? Might not the excluded (or "non-included") members of the profession reasonably ask, in the language of Scripture, "Who made ye to be judges and rulers over us?"

I am, Sirs, your obedient servant,

ONE OF THE NON-INCLUDED.

London, *December 27th.*

ELECTRICITY AS A POWER TRANSMITTER.—From Glasgow we learn that some months ago Mr. Joseph Atkinson, an *employé* of Messrs. Denny, Dumbarton, while engaged fitting zinc sheathing to the shell of the s.s. *Shark* by his patented process, used a Siemens D 7 generator, driven by an ordinary donkey-engine. Through a distance of 150 yards a power equivalent to 6 horse-power was transmitted to a motor near the vessel's side, enabling the work to be expeditiously and economically carried out. The process is, of course, available at any time.

NOTES.

ELECTRIC LIGHTING.—The Lord Provost of Edinburgh, in moving the adoption of a recommendation to the effect that the resolution of the special meeting of 14th November last to apply for a Provisional Order under the Electric Lighting Act, 1882, should not be acted upon, stated the reasons why the committee appointed had departed from their previous resolution. He said that at that time, as they would remember, there were notices of applications for Provisional Orders from no less than seven different companies. There was now only a notice from one, consequently they had no longer to fear their streets would be broken up by a great many companies, and they would only have this company to treat. In the next place, a very important meeting took place between Mr. Chamberlain, as representing the Board of Trade, and deputations from nearly all the corporations in England and Scotland. There they learned most distinctly that no permissive order would be acceptable to the Government—that the Electric Act was specially passed for the purpose of encouraging science—and it would not be permitted that any bogus order should be brought forward simply to test what the electric light could do. The matter was remitted to the Lord Provost's Committee, with powers.

THE Jarrow Town Council, after some discussion, recently came to the conclusion that it was not advisable for them to apply for a licence to supply the electric light just at present.

WE hear that the recent installations of the electric light on Tyne side are giving much satisfaction and that preparations are now being made for several important extensions.

THE Bootle Town Council, to "avoid the hasty adoption of a defective system of electric light," are to oppose the applications of the Hammond, Gülcher, and Swan companies for Provisional Orders.

ON Friday, the 15th inst., the Gülcher electric light was exhibited in Scotland for the first time. The warehouses of Messrs. P. & W. M'Lellan, engineers, Trongate, Glasgow, were lighted by five arc lamps and a series of incandescence lamps. The warehouses were visited by a large number of merchants, shipbuilders, and other business men, all of whom expressed themselves well pleased with the installation.

THE local press of Dundee say that in the midst of many failures or very partial successes, the electric lighting of the Fine Art Exhibition has been a marked success. Mr. Macwhirter, A.R.A., the eminent landscape painter, on the occasion of his recent visit to Dundee, spoke in terms of approbation of the light, which he considered superior in steadiness and purity of colour to the electric light in the Royal Academy last winter.

THE Dundee Gas Commissioners have decided to lodge an application for a Provisional Order.

THE minutes of the Glasgow Watching and Lighting Committees, dated December 15th, contain a letter from the manager of the Brush Electric Light Company in regard to street lighting by electricity, and proposing that the Glasgow municipal authorities should adopt the same plan as Dundee and Aberdeen. In these two towns the company have agreed to run a sufficient number of lamps to light the streets at so much per lamp per hour, in order that their system may be fairly tested, and be free from all expenses therewith beyond the sum per lamp agreed upon, and the usual assistance. The letter was reserved for future consideration.

THE new Royalty Theatre, to accommodate two thousand persons, and lighted with the Brush electric light, was to have been opened at Chester on Saturday night, but at the last moment it was discovered that the mechanical stage would not work, and several hundred persons had to be turned away. The electric light was tested, and was found to be a great success. The theatre was opened on Tuesday with the pantomime of *Aladdin and his Wonderful Lamp*.

ON the 20th inst. Messrs. Bell Brothers, Newcastle-on-Tyne, introduced the electric light for the illumination of their overground and underground works at South Brancepeth Colliery. The system selected was the Maxim-Weston. Nine lamps are on the pit-heap and in the engine-house, and twenty-four underground—seventeen being in one pit, and light the shaft, bottom, sidings, stables, and engine-house. A double engine with a pair of 10-inch cylinders with 20-inch stroke, at a speed of 90 revolutions per minute, which gave 800 revolutions on the dynamo, was used. A second engine is in a forward state, and will shortly be ready for work, when the whole of the surface-works, colliery offices, manager's and engineer's houses, &c., will be lighted by electricity. The engines for working the dynamos are driven by steam got from the waste heat of the coke-ovens, which are close by.

LAST week the Jablochkoff electric light was used to enable the workmen to proceed without stopping with the building of the Hôtel Métropole, in Northumberland Avenue. A successful installation of this system of lighting has just been completed at Lindal Moor Mines, Ulverston, for Messrs. Harrison & Co. Sir Henry Vivian has sent the company information of its successful introduction to his mines in Norway.

ON Saturday last the electric light was shown for the first time in the streets of Aberdeen. The start does not appear to have been quite satisfactory, but the moon was saddled with the blame. On Monday, however, the light on the streets was very much improved, while the lighting of the Industrial and Art Exhibition called forth the praises of all who visited the exhibition. The local contemporary, speaking of it, says, "The great contrast between the electric light and the gas in the adjoining hall was at once apparent. There can be no doubt that, so far as the interior lighting of the large spaces was concerned, there was no comparison between the two."

IN the First Division of the Court of Session, Edinburgh, on the 15th inst., Mr. Alison presented a petition for the New Glenduffhill Coal Company, No. 58, West Regent Street, Glasgow, asking that the Universal Electric Company, No. 4, Baltic Street, Bridgeton, Glasgow, be wound-up, and that interdict be granted against the sale of the company's effects. The respondent's company is now insolvent, and two of its creditors have already obtained decrees against it, and have advertised a sale of its effects. Their lordships granted interim interdict, and ordered the petition to be intimated to the respondents. The Universal Electric Company was incorporated in December, 1881. It was established to purchase patents for the improvement of electric lamps and apparatus used in making them, and also improvements in dynamo-electric machines. The capital of the company was originally £20,000, in 8,000 shares of £5 each. It was subsequently increased to a nominal capital of £250,000, but no part of the increase has been issued.

ON Thursday evening, 7th instant, a highly interesting and instructive lecture on "Electric Lighting" was delivered at the Town Hall, Brecon, by W. S. Rawson, Esq., M.A. (late of Christ College, Brecon), who is now with the firm of Messrs. Woodhouse and Rawson, electrical engineers, 11, Queen Victoria Street, London.

THE Yorkshire Brush Electric Light and Power Company (Limited), Leeds, is lighting the Dewsbury Theatre by means of arc lamps: one lamp is erected at the front of the building, one in the auditorium, and one focussing light on the front of the stage. At present the effect is very good for scenic purposes and the managers are quite satisfied with the result. The company are now fixing two more lamps at the wings on either side of the stage in order to counteract the shadows cast by the ballet girls from the intense light of the focussing lamp. The dynamo-electric machine is driven by a small cylinder engine in a turning shop adjoining. This is the first theatre in England lighted with arc lamps. The installation is under the supervision of Mr. A. Gay, one of the company's electricians.

THE Dover Town Council have decided to abandon their application for powers to supply electricity for lighting and other purposes.

AT a recent meeting of the lighting committee of the Dundee Police Commissioners an offer was submitted by the representative of the Brush Electric Light Company (Scotland) to maintain 16 2,000 candle-power arc lamps, the lamps to burn from sunset till daylight, for six months, at

the rate of 1¼d. per lamp per hour, on condition that the commissioners erected suitable lamp-posts and supplied engine power for the dynamo. If the company gave the engine power then the rate would be 3d. per lamp per hour. The sub-committee appointed to consider this proposal report that the terms proposed amount to three times the sum required to light the same area by gas. The offer has been rejected and the committee instructed to consider the matter further and again report.

AT Drewsbury the market place was effectively illuminated by the electric light last week. A number of elegant designs were shown to great advantage.

ELECTRIC LIGHT IN INDIA.—The opening of the Sirhind Canal at Rupar on the Sutlej, by H.E. the Viceroy of India, afforded to the Eastern Electric Light and Power Company an opportunity of displaying an installation, consisting of both Arc and Incandescence lighting, such as has never been seen in India. The camps of the Viceroy, the Lieut. Governor of the Punjab, the Civil and Military, and the Native Chiefs were brilliantly illuminated by 48 Brush Arc lamps of 2,000 candle-power each, from the 22nd until the 26th November, and the reception and dining tents of the Viceroy were lighted by 36 Lane-Fox Incandescence lamps of 20 candle-power, causing intense astonishment in the minds of the many thousand natives who crowded nightly round the engines and dynamos employed in the working—so much so that police had to be employed to keep them back. On the night of the 24th the current used for the lighting of the Incandescence lamps was transmitted to lamps lighting the Railway Station for the departure of H.E. the Viceroy. As soon as his train left the current was returned to his camp. The necessary power was supplied by three 16-light Brush Dynamos, driven by portable engines.

TRANSMISSION OF POWER BY ELECTRICITY.—At the works of the Railway and Electric Appliances Company, Polmadie, Scotland, the first practical application of the transmission of power to a distance in every-day use in Scotland has been made by Mr. Rankin Kennedy. By means of two dynamo-electric machines, designed and made by him at the above works, a power of from four to five horse is transmitted from the line shafting of the turning and fitting shop of the works through two small copper wires to the department occupied by the carpenters and pattern-makers on the opposite side of the yard of the works. The power thus transmitted is used by the carpenters and pattern-makers for driving the large saws cutting their wood, and is completely under their control. By means of a simple handle or lever a man can start a saw, cut his wood, and then stop the saw again, just as simply as if he had a small engine with steam laid on ready to start when wanted. In fact, the power is only expended when wanted. In this example of electrical transmission of power two of Kennedy's patent dynamos are used. One, the generator which supplies the current, is seated on the floor of the turning shop of the works, and is driven by a belt from the line shaft which drives all the machinery of the works. This generating machine runs all day, and from it two copper wires are led away to the carpenters' and pattern-makers' shop, which wires are fixed and connect to the other Kennedy's patent dynamo, which is seated on the floor of the carpenters' and pattern-makers' shop. This second dynamo machine receives the current from the first, and its shaft revolves at a speed of 600 revolutions per minute, and a belt from the pulley on this shaft drives the saws when the circuit is closed by the switch. Logs of wood seven inches thick can easily be cut up by the circular saw driven in this way. Mr. W. B. Brain, one of the proprietors of the Trafalgar Collieries, Forest of Dean, who for a long time past has been much interested in the application of electricity as a motive power, has lately had erected at his colliery a pump driven by electricity. In this case the pump is placed underground, and is employed for pumping the water that accumulates in the deep workings to the bottom of the pit. An electric motor is used for driving the pump, the motor being connected with a dynamo machine placed on the surface. The pump, which is of the ordinary plunger form, has a lift of some 115 feet, and has to force the water through about 500 yards of pipe to the bottom of the shaft, whence the water is raised by the ordinary steam pumps. The quantity of water thus raised is 2,400 gallons per hour. The result of this application has proved most satisfactory, and Mr. Brain proposes to still further extend the system of electrical transmission of power. The electrical arrangements were intrusted to the Pyramid Electric Company, and were carried out under the supervision of the managing director, A. Le Neve Foster, Esq.

THE TELEPHONE IN SCOTLAND.—The Aberdeen Town Council are, in future, to include a charge of 10s. in the statement of Fire Attendance Expenses in respect of the telephone connections which have been provided by the Council between the residences of certain members of the fire brigade and the police officer. The number of fires per annum is given as 30, and the telephone connections cost about £1 a fire. The Insurance Companies are to pay the second half of the £.

FROM a popular lecture on "The Telephone," delivered by Mr. Ross, the National Telephone Company's Manager, on Saturday, the 16th inst., at Aberdeen, it appears that there are already 100 subscribers to the Exchange, and applications for nearly as many more are waiting acceptance.

THE telephone is being rapidly extended in Dundee; both Companies registering from 9 to 16 new subscribers weekly.

FROM Edinburgh and Glasgow good progress is reported.

WINTER ELECTRIC EXHIBITION, ROYAL AQUARIUM, WESTMINSTER.—The engineer to the Exhibition, Mr. Will. D. Gooch, informs us that it is shortly to be opened. Motive-power to the amount of nearly 500 horse-power has been arranged for by the direction of the Aquarium, in the buildings specially erected as machine annexes. The body of the hall will be devoted to arc lighting, which will be represented by 14 or 15 systems, several being new. The space underneath the galleries and the galleries themselves are subdivided into courts for the purpose of exhibiting the several systems of incandescence lighting and fittings applicable to it. The ground floor of the whole of the building and parts of the galleries are apportioned out to exhibitors for the purpose of displaying the different accessories of electrical application, the most notable feature of which will be the motors, 14 in number, which will drive machinery. The dining annexe will be lighted by Messrs. Ferranti, Thompson & Ince, with 350 incandescent lights, actuated by one of their new machines. There are five courts fitted up for the display of the Edison electric light and the different features of the Edison system. All the remaining courts are occupied by other firms to illustrate either new incandescence lamps or fittings for their use. Thus the whole of the premises of the Aquarium will be occupied for the exhibition, which will very fairly represent all the present systems of lighting and transmission of motive-power by electricity.

The Metropolitan Brush Company have contracted to light up the Imperial Theatre during the course of the exhibition, and we understand that their installation will be ready by January 6th. The exhibition is easily accessible, and should not fail to prove of great interest.

A ROYAL SUBSCRIBER TO THE TELEPHONE EXCHANGE.—Ajuda Palace, the town residence of His Majesty Don Luiz I., King of Portugal, was early this month connected to the public telephone exchange in Lisbon, Don Luiz thus being the first European monarch who has had a telephone line to a public exchange. The majority of the ministers are already connected to the exchange from their respective *Gabinetes*, as well as the Civil Governor, General Commander of the Military Division, Municipality, and the Commander of the Municipal Guard, to which last His Majesty first spoke, in order to try the telephone, with which he expressed his complete satisfaction and surprise, as "the voice of the general seemed to come from inside the case," as also with the elegant appearance of the instruments, which consist of a Gower-Bell and magneto call mounted on a backboard, the whole being specially got up in black and gold by the Telephone Construction and Maintenance Company. His Majesty honoured Mr. H. S. Samuel, the manager of the company, and Mr. A. Danvers, the company's engineer, with an interview on the occasion, during which the telephone and the way it is used were explained to him.

NEW PATENTS—1882.

5961. "Dynamo or magneto-electric machines." G. L. ANDERS and J. B. HENCKE. Dated December 13.

5977. "Galvanic batteries." J. RAPIEFF. Dated December 14.

6002. "Apparatus for lighting interiors by electricity and other illuminating agents." A. M. CLARK. (Communicated by G. Trouvé.) Dated December 15.

6003. "Electrical conductors, couplings, switches, and terminal connections." S. H. EMMENS. Dated December 15.

6004. "Electrical installation fittings." S. H. EMMENS and R. I. BARNES. Dated December 15.

6019. "Dynamo-electric machines." W. S. HOBBY. Dated December 16.

6020. "Telephonic apparatus." G. L. ANDERS and J. B. HENCKE. Dated December 16.

6023. "Telephonic apparatus." W. R. LAKE. (Communicated by G. M. Torrence.) Dated December 16.

6046. "Electric lamps or lighting apparatus." H. H. LAKE. (Communicated by J. Kremenezky.) Dated December 18.

6067. "Electrical gas lighting apparatus." S. E. PATTISON. (Communicated by W. A. Drysdale and C. W. Bailey.) Dated December 19.

6075. "Incandescent electric lamps." L. A. GROTH. (Communicated by A. Bernstein.) Dated December 20.

6083. "Electro-motors or machines for generating electricity." L. MILNE and L. B. MILLER. Dated December 20.

6085. Telephonic apparatus." W. R. LAKE. (Communicated by M. F. Tyler.) Dated December 20. (*Complete.*)

6102. "Insulator for telegraphic and like wires." A. G. BESSOMAIER. Dated December 21.

6105. "Electric meters." F. H. VARLEY and J. R. SHEARER. Dated December 21.

6118. "Construction of the receptacles or vessels of secondary batteries." G. BINSWANGER. Dated December 22.

6146. "Dynamo-electric, magneto-electric, or electro-dynamic machines." R. MATTHEWS. Dated December 23.

6150. "Automatic electric signalling apparatus for railways, also applicable to other purposes." H. J. HADDAN. (Communicated by H. Fortin and J. J. Langlet.) Dated December 23.

6153. "Electric and other lamps." J. M. FLETCHER. Dated December 23.

6164. "Apparatus for the production of the electric light." A. M. CLARK. (Communicated by L. Gérard and W. V. Bonsor. Dated December 23.

6183. "Electrical generators and motors." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated December 27.

6185. "An improved electric arc lamp." A. M. CLARK. (Communicated by Solignac et Cie.) Dated December 27.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1896. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated April 20. 6d. This invention has for its object improvements in telephonic and telegraphic signalling apparatus. The purpose of this invention is to enable a number of stations connected by one line-wire to communicate under such conditions that any station can speak to any other, the remaining stations meanwhile being prevented from overhearing or interrupting.

1901. "Voltaic batteries." A. R. BENNETT. Dated April 21. 4d. This invention has for its object the production of an improved cheap and effective voltaic battery, and is a further development of the invention for which letters patents have been granted to the said A. R. Bennett, No. 302, 1882. To form the negative portion of this improved battery, the inventor uses an electrode of iron, steel, copper, gold, silver, nickel, cobalt, or any of the platinum group of metals, the shape of which is immaterial, with or without a packing of fragments of the same metal placed in, or containing, a solution of potassium monoxide, potassium hydroxide, sodium monoxide, or sodium hydroxide. These monoxides or hydroxides may be used separately, or they may be mixed. The inventor also uses a solution of permanganate of potassium mixed with one or more of the foregoing solutions, excepting those of sodium monoxide or sodium hydroxide.

1915. "Electric lamps." W. T. WHITEMAN. (A communication from abroad by Messieurs M. Bauer and Company of Paris.) Dated April 22. 6d. This invention consists partly of improvements on an invention for which letters patent, No. 2038, dated 10th May, 1881, were granted to H. J. Haddan, and the said improvements consist firstly in using a horseshoe electro-magnet for actuating and controlling the motion of the carbons in electric arc lamps, the said magnet being so mounted in the lamp as to be capable of vibrating or turning on pivots or axes formed at the ends of the bar by which the two limbs of the magnet are connected. The said two limbs of the magnet are of unequal length, and the pole of the longer limb is curved with a radial curve, the centre of which is the axis on which the magnet turns. The said magnet is so mounted in the lamp that the pole of its shorter limb bears against the iron rod carrying the upper carbon. The said improvements consist further in forming the pole of the shorter limb of the magnet which bears against the rod carrying the upper carbon, as hereinafter described.

1919. "Electric arc lamps." J. LEA. Dated April 22. 6d. Has for its object the better regulation of the feed of the carbon or carbons, in order to insure a steady light; and at the same time to be able to employ carbons of greater length than heretofore. According to the invention, the upper carbon is held in position by rollers (by preference, three), two of which are held in a metal frame for their bearings, while the third is a riding or "jockey" roller, adjustable to any given pressure by means of a spring and adjusting screw. These rollers are so constructed as to allow of different sized carbons being placed between them. The feeding action for lowering the upper carbon, as consumed, is as follows: A solenoid or an electro-magnet is employed and actuates a gripping lever for the purpose of revolving the rollers, and this solenoid, or electro-magnet is connected as a shunt from the main circuit. This shunt circuit is divided to allow of a variable resistance in order to increase or decrease the motion of the feeding lever. A second solenoid or electro-magnet is employed to form the arc by separating the upper and lower carbons. A projecting arm is placed upon the frame of the jockey roller in such a position that, should the carbons be apart, the feeding solenoid or electro-magnet acts upon and releases the jockey roller, and allows the carbons to come into contact. A short-circuiting arrangement is placed upon the frame of the jockey roller, so that when the upper carbon is consumed, a contact is made, and the lamp cut out, but allowing all the other lamps in the same circuit to continue burning.

1940. "Electric batteries." W. R. LAKE. (A communication from abroad by Louis Maiche, of Paris.) Dated April 24. 6d. Relates to the battery described in the number of the Review for April 15th, 1882.

1945. "Telephone alarms." W. M. BROWN. (A communication from abroad by J. F. Kettell, of America.) Dated April 25. 8d. Relates to the apparatus described in the number of the ELECTRICAL REVIEW for July 15th, 1882.

1946. "Secondary batteries." C. V. BOYS. Dated April 25. 6d. Relates to improvements in the construction of secondary batteries whereby a considerable economy of time may be effected in the operation of "forming" such batteries, whilst at the same time better results are obtained. According to the invention, in lieu of coating the lead plates of secondary batteries with oxides or salts of lead, the inventor coats metallic plates or other supports with a layer of finely-divided lead produced in the manner next hereinafter described. For this purpose he melts lead and pours it into a box or suitable receptacle in which it may be gently moved until it begins to granulate. He then causes the box to be violently shaken, by machinery or otherwise, so that the lead is thrown in all directions in the box and reduced to a fine powder. When sufficiently cool, the powder is removed and sifted from larger particles. This lead dust may then be shaken up with a weak solution of mercury and washed with water. It is then spread in layers on metallic plates or other supports, and compressed sufficiently to make it bind together. The plates are then arranged so that they may lie in a weak acid solution; or, in lieu of spreading the lead dust on plates or supports as before mentioned, it may be consolidated so as to render an artificial support unnecessary, the electrodes so prepared being used in a weak acid solution as before.

2037. "Manufacture of electric incandescent lights in the vacuum." A. L. JOUSSELIN. Dated April 29. 2d. Relates to the manufacture of incandescent lamps, and consists in, first, the means of constructing the transparent shell and insulating the conductors; second, the treatment of the materials from which the incandescing carbons are made; third, the manufacture of the incandescing carbons; and fourth, the attachment of the carbons to the conductors. (*Provisional only.*)

2092. "Electric light apparatus." C. LEVER. Dated May 3. 8d. The first part of this invention has for its object improvements in electric lamps where the light results from the electric current passing between points or pencils of carbon. The way the inventor accomplishes this part of the invention is preferably by commencing in an inverse manner to that usually employed in electric arc lamps, *i.e.*, the carbon electrodes in the lamp do not make contact with each other before the electric current is sent through the lamp. Instead of employing an electro-magnet or solenoid in the main circuit to separate the carbon points for the production of the voltaic arc as is usually the case, the inventor employs an armature lever in combination with a spring, weight, gaseous or fluid pressure to separate the carbon points to the required distance for the display of the voltaic arc, this distance being regulated by means of a set screw acting on the said armature lever and limiting its movement. Acting on the opposite end of this armature lever, and in an opposite direction to the spring weight, gaseous or fluid pressure is an electro-magnet in a shunt circuit of a considerably greater resistance than that of the arc from which it is shunted or derived. The armature lever is free to move on a pivot or fulcrum pin fixed to the casting, preferably of brass or other diamagnetic metal—in which are enclosed the shunt electro-magnet and clip or other device by which the said armature lever can raise the upper carbon holder—which slides through the said casting—by means of the said spring, weight, gaseous or fluid pressure.

2125. "Producing electric currents." K. PARZELSKI. Dated May 5. 2d. For the purposes of invention the inventor digs a pit or hole so deep as to be at its bottom perpetually covered with water. Into it he places zinc in any quantity, large or small, according to the force to be produced. Then by the side of the zinc, or at any distance, even though thousands of miles from it, but also in a pit or hole like that just described, are placed one or more pieces or plates of some other metal, or, still better, some mineral containing large quantities of carbon, for instance, coal, coke or graphite. After having then connected the zinc with the other mineral, by means of a good conductor, for instance an iron wire, the inventor obtains a

vigorous galvanic current. This current has, moreover, the property that its conductor does not require isolation, and can therefore be placed without any isolating envelope in the ground and even in water ! ! ! ! ! (*Provisional only.*)

2128. "Regulating and utilising electric currents." W. ARTHUR. Dated May 5. 6d. The object of the invention is so to affect a subdivision of the electric current used for lighting electric lamps or other purposes, that the resistance shall remain the same whether the current is turned on to the electric lamp or otherwise, whilst at the same time there is no loss of power whilst the current is not being utilised. To attain this object, the inventor breaks up the main cable at two stations, say, at different ends of a street, into a number of smaller cables or wires, equal to the number of lamps required between the stations, and each wire is connected and balanced so that the resistance may be equal. At the lamp the current when not in use passes through an accumulator, or some other resistance, equal to the resistance of the electric lamp, and the wires are so arranged that when the current is turned on to the electric lamp,or used for other purposes, the accumulator or resistance is cut out.

2135. "Forming lead for secondary batteries, &c." T. CUTTRISS. (Partly a communication from abroad by C. Cuttriss, of America.) Dated May 6. 4d. Relates to a process of forming or preparing lead in the shape of plates, or otherwise, for secondary batteries or magazines of electricity, by means of combinations in suitable proportions of sulphuric acid, nitric acid, and chromic acid, and an electric current; also to an improvement in the construction of batteries whereby a more enduring battery is obtained.

2136. "Incandescent lamps." J. RAPIEFF. Dated May 6. 4d. This invention consists of improvements in the construction of electric lamps made with carbon filaments or strips, by the carbonisation of suitable organic substances cut before or afterwards in proper shape or form, and the deposition upon them of pure carbon from carboniferous liquids, gases or vapours, by electricity, or heat, or both. Besides the ordinary means, the carbon filament may be made by the carbonisation of organic substances such as collodion prepared from gun-cotton flux, &c., and deposited from the solution by suitable means in the shape of sheets, plates, or ribands or threads, after which upon this may be deposited carbon in a pure state from liquid gases or vapours. Under the names of carboniferous gases or vapours the inventor uses gasoline, benzine, chloroform, &c., but of more importance, gases or vapours obtained from liquids not containing hydrogen, such as chemical compounds of carbon with chlorine and bromine, sulphur and iodine, separate or together, or a mixture of these or any other substances similar in natures. To obtain the carbon filament by this deposition of the pure carbon thereon from the above-named gases or vapours, not only of equal resistance but also of the same fineness of the grains of deposited carbon, the inventor uses an improved automatic arrangement. The volume or fineness of the grains of the deposited carbon on the said filament depends upon the temperature to which it is heated (by the passing of the current through it), providing this temperature is high enough to decompose the surrounding carboniferous medium. (This process may be called the treatment of the filament.) It is obvious therefore that if the temperature of the filament remains the same or changes regularly the same fineness of the carbon deposit will result. To obtain this necessary result the inventor divides the electrical current into as many branches as possible, according to its strength and the requirements, and inserts in each of these branches the filament to be treated and an automatic electrical or magneto-electrical arrangement which will come into play when the filament has acquired the proper resistance, will cut off the heating current from it and at the same time substitute in the circuit a resistance equal to that of the completed filament; it is evident that the current in the other branches where the other filaments are in the course of treatment will not be affected. For the more effectual sealing of the conductors the inventor forms the lower part of the bulb, or case into a tube, cylindrical and slightly conical; after the introduction of the carbon filament clamps and conductors into the bulb, he takes a glass thimble or cup of such a size as may be conveniently introduced into this tube, leaving the annular space for the conductors as small as possible. To complete the sealing and to produce uniformity in the size of the finished lamps, the inventor heats to the necessary degree the said tubular part of the lamps and thimble, and after introducing into the latter a suitable core or tool, he squeezes the whole together to form the desired shape.

2138. "Apparatus for producing electric currents, &c." A. MILLAR. Dated May 6. 2d. Relates to improvements in apparatus for producing electric currents, and which may also be employed for obtaining motive-power. The improvements consist in employing, for the purpose of producing electric currents, an electro-magnet, or a permanent magnet, so constructed that each of the two poles of the magnet forms circles concentric with, or disposed symmetrically to each other, so that the space which separates the two circles is also circular. (*Provisional only.*)

2144. "Electric lamps." J. H. JOHNSON. (A communication from abroad by J. M. A. Gérard-Lescuyer, of Paris.) Dated May 6. 6d. Relates to electric lamps and consists of a peculiar method of arranging and supporting the carbons or candles.

2186. "Incandescent electrical lamps." H. LEA. Dated May 9. 6d. Has for its object to facilitate the connecting and disconnecting of incandescent electrical lamps to and from the brackets and supports carrying them and simultaneously connecting and disconnecting the carbon filament of the lamp with the electrical conductors by which electricity is supplied to the lamp.

2184. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 9. 2d. A hollow iron cylinder, free to move, has another cylinder inside it. They are united together or worked out of the solid. This compound cylinder is mounted so as to rotate upon its axis. Magnetism is imparted to it by an arrangement of magnets or a hollow helix surrounding it, so that the double cylinder forms one of the poles of the magnet. In between these two cylinders is placed another magnetic cylinder which may be stationary or made to rotate. This cylinder is wrapped with wire parallel to its axis. This cylinder forms the other pole of the magnet. (*Provisional only.*)

2185. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 9. 2d. This invention is designed for the production of rotary motion from electric currents or electric currents from rotary motion, and for getting rid of or greatly reducing the burning at the places of contact. Where the word magnet is used in this specification it is to be understood that any magnetisable metal is meant. The magnets are sometimes permanent, sometimes electro-magnets according to circumstances. The first method of carrying out this invention consists of placing two or more magnet bars end to end free to rotate axially in either direction. Near to or surrounding each bar is placed the hollow pole of a magnet. Each alternate bar may be a fixture. On passing a current through the bars rotation is produced. These rotating bars are connected by gearing or otherwise with the apparatus to be moved. If the bars are rotated a current of electricity is generated. The second method of carrying this invention into operation consists of a long magnet bar having magnet discs upon it. The discs have near them or around them a magnet ring, and the bar in between the discs passes through a hole in a magnet, or a magnet or magnets are brought near to it. If the north poles of the magnets be presented to the discs the south poles of the magnets are presented to the bar between the discs. On passing an electric current through the bar from end to end rotation is produced. The discs may in some cases be insulated from the iron bar and have spring rubbers connecting the circumference of the disc with a point near the centre of each disc. When the bar is rotated currents of electricity flow between the centre and circumference of the disc. For the convenience of constructing this machine each alternate magnet has a disc screwed into it. This disc has a hole through which the bar passes; in order to put this disc over the bar it is made in two halves and pinned together so that when put together and screwed inside the pole of the fixed magnet it acts as a portion of it. (*Provisional only.*)

2207. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 10. 2d. This invention may be constructed with one moving spindle, but two or any multiple of two spindles are preferred. The object is to get a conductor moving between the poles of magnets so as to generate currents of electricity. A description of the apparatus with four parallel spindles will illustrate other combinations. On the further end of the left-hand spindle is placed an insulated conducting disc. On the rest of that spindle are placed insulated conducting reels. On the intermediate spindles are placed insulated discs. On the right-hand spindle are placed insulated reels, and at its near end an insulated disc. These discs and reels are either geared together by teeth cut in their peripheries, or are made to overlap each other and touch, or nearly so, or they may rotate between fixed pieces of conducting materials curved so as to fit portions of the peripheries. When combined, they form a continuous conductor from left to right, back from right to left, and so on. These discs are slotted from the circumference towards the centre to prevent false conduction. These slots may be filled with non-conducting material, such as vulcanite. In order to make the resistance at the junctions as small as possible, jets of fluid metal (such as mercury) are made to play upon them, or the discs may dip into trays of fluid metal to effect the same purpose. In between these discs are placed poles of magnets, so that the rotating discs cut the magnetic rays and produce one continuous current from one end of the machine to the other. (*Provisional only.*)

2225. "Dynamo-electric machine." T. FLOYD and T. KIRKLAND. Dated May 11. 2d. It is proposed to make the field magnets themselves revolve, and in a direction opposite to that of the armature, so that if both were being driven at a speed, say, of 1,000 revolutions per minute, the speed with which the lines of force were being cut would be the same as if the field magnets were fixed and the armature driven at 2,000 revolutions per minute—thus getting the same result from a machine driven at a moderate speed, as one constructed on the present system driven at a very high speed, or if driven at a maximum speed obtaining twice the amount of electricity that could be obtained from one constructed on the ordinary plan. The specification also relates to the general construction of the machine. (*Provisional only.*)

2226. "Incandescent electric lamp." T. FLOYD and I. PROBERT. Dated May 11. 2d. The improved incandescent electric lamp which forms the subject of this application for letters patent is constructed as follows:—The inventors take a glass globe, either spherical or not, and provided at both top and bottom with a stem or prolongation, and, having exhausted the air from the globe, they place inside it one or more carbonaceous fibres at approximately equal distances from each other, and from the centre of the globe. These fibres are attached at each end to the opposite conducting wires of the electric source, the said conducting wires passing through the stem or prolongation of the globe. (*Provisional only.*)

CITY NOTES, REPORTS, MEETINGS, &c.

THE PHŒNIX ELECTRIC LIGHT COMPANY.

A MEETING of the above company was held at its offices in George Street, Hanover Square, at eleven o'clock a.m., on the 22nd inst., in pursuance of a notice issued by the directors, in order to discuss and pass a resolution for the voluntary winding-up of the company.

After the Secretary had read the notice convening the meeting,

The Chairman, in a few words, stated that the reasons for the proposed winding-up were the collapse in the value of electric undertakings, promises by various persons to take shares not having been fulfilled, many shareholders having failed to pay the calls, failure to dispose of concessions, and the vendor refusing to grant further time

for payment of purchase-money. The Chairman urged that the directors considered these reasons quite sufficient, and asked the meeting to carry the resolution for a voluntary winding-up, which he then moved.

The motion having been seconded,

Mr. C. P. Whiteley stated that he did not doubt but that every shareholder would agree with the directors that a winding-up was inevitable, but that, for his part, all agreement with the directors ended here, and that he would endeavour to prove that the directors were not fit and proper persons to be intrusted with the winding-up. In the first place, he protested most strongly against the meeting being called at such an unusually early hour as eleven o'clock in the morning. The offices were in the West End, and it was impracticable for many business men to get there so early, besides which many country shareholders would be able to attend only by staying the previous night in London. The reasons given by the chairman for the winding-up were not the true ones. As to the non-payment of calls there was a legal remedy, so that that excuse was a frivolous one. As to promises to take up shares not being fulfilled, he contended that excuse proved that the directors improperly proceeded to allotment on shadowy promises of support. If these promises had been *bonâ fide* made, why did not the directors get the persons making them to apply in the usual way and stake the application money. As to failure in disposing of concessions he remarked that the prospectus stated that one offer was actually made for Scotland alone for £40,000, and that other offers to the extent of £145,000 were under consideration. As to the vendors closing the contract he ventured to assert that it was an arranged thing in order to offer some show of excuse for getting out of liability. He asserted that the true reason for asking a voluntary winding-up was that the promoters and directors who were in the same boat, saw that they could not galvanise this corpse of a company into a semblance of vitality, that this phœnix would *not* rise from its ashes, and they wished to shirk their liability under a winding-up voluntary, that is, under their own auspices and in the way that suited them—not the shareholders. In due course he would propose an amendment, but he would first prove that the directors were not competent to distribute such assets as remained. The chairman stated that the directors had a heavy stake in the concern. Well, what was their stake? Three of them held 500 shares each, one 100 shares, another, a baronet, had risked the enormous sum of five pounds in the concern, and the remaining one the same stupendous sum of five pounds. No doubt most of the shareholders had been caught by the glowing prospectus which deliberately stated that an offer to purchase the concession for Scotland for £40,000 had been received and that further offers to the tune of £145,000 were under consideration. Now, the first issue of shares was to be £125,000. What a tempting bait! An enormous profit to start with. The directors now quietly say they have failed to dispose of any concessions. Who made the offer? Was any deposit made? If these offers were at all doubtful why were they made *the* feature of the prospectus? The prospectus held out that the business of the company would be:—The manufacture of electrical apparatus, the lighting of cities, towns and *villages* (why not go down to cow sheds at once?) in England, Scotland, Ireland, the Isle of Man and the Channel Islands, the manufacture of chemicals and the supply of motive-power. Now, then, what capital did the directors consider sufficient to carry on all this magnificent show of business? The public were allotted shares to the extent of £13,691, so that the concern was started with the sum of £13,691 as the utmost that could be received by calls to the full amount, and this would take three months at the earliest by the articles, the actual cash received on allotment, previous to calls, being £3,415. Now, the first thing to be done was to pay to the promoters, according to agreement, £5,000 for the expenses of the promotion. Next, the sum of £30,000 in cash had to be paid to the promoters as part of consideration money. How much was left to manufacture dynamos, apparatus, and chemicals, pay salaries, directors' fees, agents' commission, and travelling expenses, purchase furniture, and light up the whole of England, Ireland, &c., &c., as per prospectus? Further, we were clogged with an "old man of the sea," in the shape of a £40,000 sleeping partner, that amount being credited in shares to promoters as balance of purchase. So that the case stood thus: When we had paid £5,000 for expenses of promotion, £30,000 to promoters as part purchase, and bought office furniture, &c., we could start business; but then Mr. Promoter, sleeping partner, says: "I want two-thirds of all the profits; you who find the coin must be content with one-third." It was gross incompetence (if not worse) for our directors to start business with *no* capital—for our £13,691 belonged to promoter as part of £5,000 and £30,000—he repeated with *no* capital, a debt of £16,309, and a partner to take two-thirds of the profit. Not content with mismanaging the concern so far, the directors on the 24th June entered into an agreement with the promoter, whereby the £70,000 purchase-money was to be paid, £45,000 in shares and £25,000 in cash. What right had the directors to do this without consulting the shareholders? and ought they not to have returned the allotment money at once? It was the old story, "Don't let the money go back, we'll take anything rather than nothing." However, not content even with this the directors, having started a Bankrupt Company over head and ears in debt, plunge a little further into the mire, for on the 4th of July these gentlemen actually enter into an agreement to purchase from an Electric Light Syndicate some patent of an indefinite nature for the sum of £40,000. Where on earth was the money to come from? He had not had time to search the agreements between the vendors, promoters, and secretary, to see if the usual clause precluding the directors proceeding to allotment on an insufficient application for shares was inserted, but if these agreements permitted an allotment on £14,000 worth of shares, then there was again gross mismanagement somewhere. Now the directors asked for a voluntary winding-up. What specially prompted them to desire it to be voluntary? Why he asked that question was this:—He had taken the trouble to examine the register of shareholders, and in it he found Mr. Waters, the promoter, credited with 45,000 shares. This was *ultra vires* to begin with, being contrary to prospectus. He also found that Mr. Waters was debited with 27,243 shares transferred and sold to other persons, leaving only 17,757 then standing in his name. Why did the directors allow this? If the promoter had been a man of honour, he would not have parted with a single share until the company was properly and honestly floated. What did it look like? Why, that Mr. Waters saw that the bubble must burst, and took care of No. 1. £27,243 was better than nothing. If he could so readily dispose of £27,000 worth of shares, why did he not place some of the unallotted shares of the company, and so enable them to start business with some pretence to capital? No doubt Mr. Waters thought this £27,243 was safe in his pocket, but that remained to be seen. He (Mr. Whiteley) would do his best to make Mr. Waters disgorge. Another curious disclosure remained to be brought to the light. A Mr. Jabez Poulson had applied for 1,000 shares, and the directors have actually taken his promissory note for £250 for the amount of deposit and allotment money. Well, he maintained that as the directors had chosen to accept the responsibility of taking a promissory note they were personally liable for the amount. Now he was not aware how many writs had been issued against the company, but he knew that one writ had been issued against the company by a holder of 500 shares for a return of the money paid by him on the ground of misrepresentation. In order to stop these writs, and to secure a fair distribution of the assets, Mr. Hough, a large shareholder, had in conjunction with himself presented a petition for the winding-up of the company under the direction of the High Court of Justice, and that petition would be persevered with to the end in default of satisfactory terms being made with the *bonâ fide* shareholders. The promoters ought to return to the shareholders the whole of the money they had paid. The promoters would then only have to bear the cost of floating the company, which ought never to have been floated, and the cost of winding-up would be saved. If the petition went on the petitioners would most assuredly try to make the promoters and directors responsible personally for their misrepresentations and mismanagement. If the directors would like time to consider his proposal he would consent to this meeting being adjourned for a fortnight, but if they pressed their resolution he would move as an amendment—"That this meeting cordially supports the petition for winding-up, under the direction of the High Court of Justice, and authorises the petitioners to proceed with the petition with energy and despatch." Those shareholders who cared to give their support to the petition would incur no liability by so doing, as he was not standing alone in the matter, and he had sufficient guarantees from influential shareholders to cover expenses in the event of failure, an eventuality he did not anticipate for one moment. In conclusion he urged the shareholders not to throw in their lot with the directors, gentlemen who, however worthy they might be in the outside world, had displayed in this miserable concern such lamentable incompetence.

Mr. Tompsett thoroughly agreed with all Mr. Whiteley's remarks. The affairs of the company had not been properly started and culpable neglect had been shown by the directors. He thoroughly supported the winding-up under the direction of the Court as the only satisfactory course open to them and he begged to second the resolution to that effect moved by Mr. Whiteley.

Mr. Hough stated that the object of the petition was not to wreck the company, and if the directors could satisfy the shareholders, well and good, but if not, then the shareholders must, of course, look out for their own interests. Bearing this in mind, he thought the suggestion for an adjournment was a good one and hoped the directors would accept it.

A long discussion then took place, in the course of which the chairman stated that the amount of cash in hand was £737, but that the assets would be considerably more than this, as the vendor was bound to return the cash paid under agreement. With regard to the shares held by the promoter, the directors were awaiting legal advice as to whether these would participate in the distribution of assets. Of the shares transferred by Mr. Waters, 14,000 had been transferred to the first vendor.

After a consultation the directors decided not to press their resolution for voluntary winding-up at that meeting, and accepted the suggested adjournment. The meeting consequently stood adjourned for a fortnight.

THE FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).—This Company offers for public subscription 25,000 Preference shares of the French Electrical Power Storage Company (Limited), at the price of £12 per share, the interest on each share being 6s., or 7f. 50c., each half-year. The Faure Company guarantees the interest, and the shares will be redeemed by drawings in 30 years at £20. The issue is made in pursuance of certain arrangements announced at the recent special meeting of the Faure Company, which M. Philippart induced the shareholders to accept. The French Storage Company have exclusive rights to the Faure patents in France and the French Colonies, and they intend to proceed on the method of granting licences to subsidiary companies, which was carried out so extensively by the Anglo-American Brush Company, and, as *The Times* remarks, "with results which are now seen to have been by no means altogether satisfactory."

REMOVALS.—The offices of the Gower-Bell Telephone Company (Limited), the Consolidated Telephone Construction and Maintenance Company (Limited), and the River Plate Telephone and Electric Light Company (Limited), have been removed from No. 6, Lombard Street, E.C., to the Telephone Works, Farringdon Road, E.C. Edison's Indian and Colonial Electric Company (Limited) has been removed from No. 6, Lombard Street, to 4 and 6, Throgmorton Avenue, Throgmorton Street, E.C.

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